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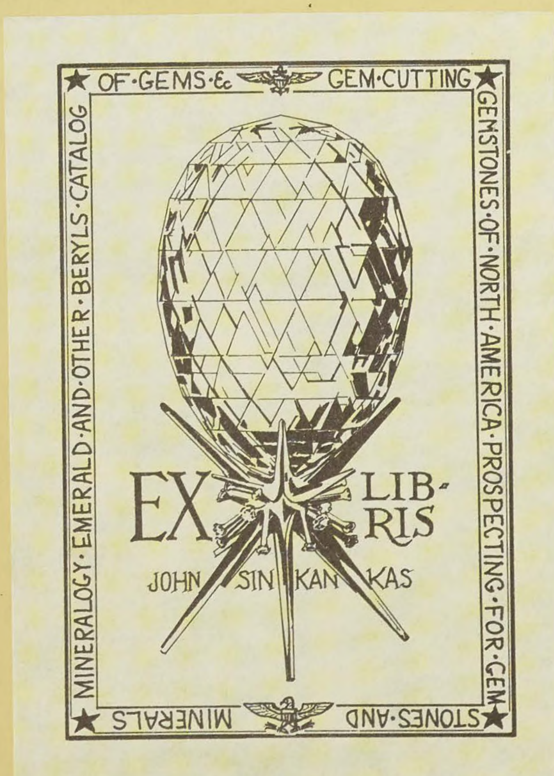

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MINERALS

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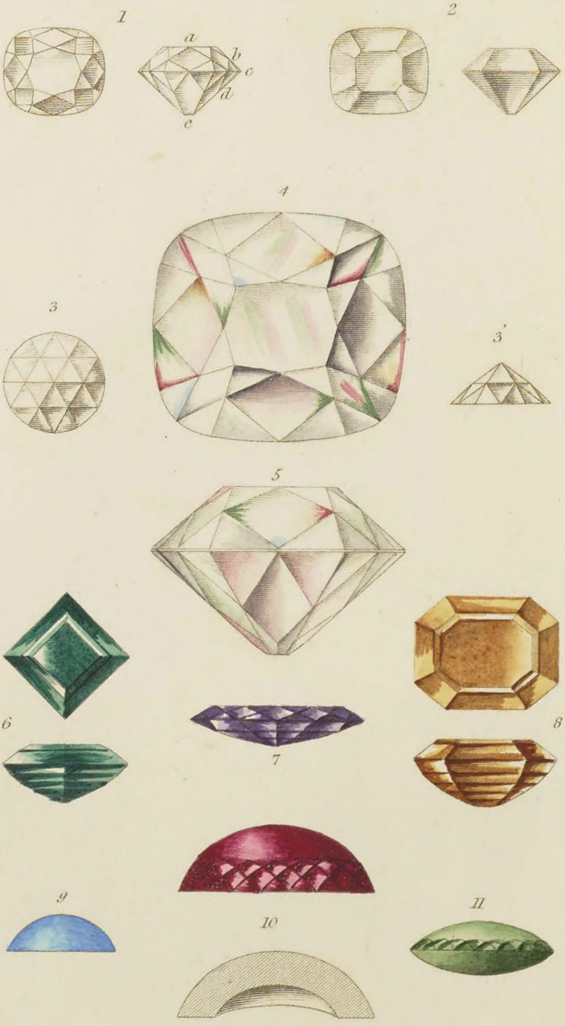

J. W. Lowry fc.

London, John W. Parker, West Strand, 1849.

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MINERALS

AND

THEIR USES.

IN

A SERIES OF LETTERS

TO A LADY.

BY

J. R. JACKSON, F.R.S.,

MEMBER OF THE IMPERIAL MINERALOGICAL SOCIETY
OF ST. PETERSBURG.

Hence Labour draws his tools; hence burnish'd War
Gleams on the Day; the nobler works of Peace
Hence bless mankind, and generous Commerce binds
The round of Nations in a golden chain.

THOMSON.

LONDON:
JOHN W. PARKER, WEST STRAND.

M.DCCC.XLIX.

1849

PREFACE.

THE Author thinks it right to acquaint the reader, that if the information contained in the present volume is in Letters, it is because it was originally given in that form. The greater number are *bona fide* letters, that were written for the instruction of a young lady; but the writer's duties not allowing him time to continue the correspondence, it was broken off, and has not since been renewed. Having now more leisure, he has revised the copies of the letters already written, and added others in completion of the task he had originally undertaken.

This Volume is not to be regarded as an elementary book, still less as a Treatise on Mineralogy. Its object is to convey such information on the more important Minerals and their uses, as an enquiring mind may be desirous of possessing, without going minutely into the subject; and for this purpose, the epistolary style offers peculiar advantages.

It is also needless to say, that these Letters contain nothing new. The descriptions of the minerals are given either from specimens in the writer's own collection, or are taken from different treatises on Mineralogy—while the particular anecdotes or facts connected with the subject have been gleaned at different times from various reading.

The lady for whom these letters were composed, was young and well-informed on several subjects, and although eschewing all blue-stockingism, desirous of every kind of knowledge that could enlarge the sphere of her ideas, enable her to take her part in rational conversation, and fit her to be the companion of a man of sense. There are many such young ladies, and it is for their use that this correspondence is now printed—a correspondence which if it does not contain much, comprises, the author hopes, quite enough, and in which nothing is given as fact but what is well authenticated.

In the course of these letters, reference is occasionally made to the acid and blow-pipe characters, definite crystalline forms and specific gravity of some of the minerals mentioned. This has been done with a view to more complete definition, not with the intention of inciting ladies to burn their

pretty fingers with acids, or distort their features by the use of a blow-pipe. Simpler modes of recognizing minerals are given for their special use in an Appendix, for which the Author is indebted to the kindness of his friend Mr. E. J. Chapman, whose valuable papers on Analytical Mineralogy, and other works, are justly appreciated.

ERRATA.

Page	Line	Error.	Correction.
28	13	Guidean	Cnidean
32	30	Swanhard	Schwanhard
73	1	and elsewhere, *for* Leyman	Lehmaun
80	30	*entaille*	*intaille*
86	13	it is	they are
95	22	found	formed
151	24	Simes	Symes
179	3	Maro	Marco
206	4	Scheekenstein	Schnekenstein
224	10	coloured	colourless
244	6	Saxony	Hungary
264	6	Glacinum	Glucinum
308	25	Antiquarian's	Antiquary's
371	20	is	are

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DESCRIPTION OF THE PLATE, ETC.

FIG. 1 Two views of a brilliant cut Diamond (*see* p. 214). a, the Table; b, the Bizel; c, the Girdle; d, the Collet-side; e, the Collet.

2 A Diamond having the same general form and proportions as the preceding, but with only the primitive edges bevelled, and the Bizel being without triangular facets. This cut preserves more of the stone, but has not so great a play of colour as the Brilliant.

3, 3′ A Rose Diamond of the ordinary cut, not the perfect cut described at page 215.

4, 5 Two views of the Pitt or Regent Diamond of the exact size and cut (*see* p. 220).

6 An Emerald cut in steps, with a large table and step-formed Bizel.

7 An Amethyst, with a worked Bizel and Collet-side in steps and ribs.

8 A Topaz, or a Yellow Crystal, with a large table, plain Bizel and Collet-side in steps, with a curved outline.

9 A Turquoise. Plain spherical or *en Cabochon;* flat below.

10 A Garnet. Spherical with a worked Bizel; the section below shewing how this stone is hollowed when too deep in colour.

11 A Chrysoprase, convex on both sides, with a row of facets on the upper side.

The mode of cutting the stones used in jewellery differs in different countries; nevertheless, there are certain principles by which the lapidary is guided in his art. Among these we may mention the following:—

For stones in general, the cut depends greatly upon the size, shape, and perfection of the stone.

Opaque stones must have their defects cut away, as there is no method of concealing them otherwise, than by so setting the stone that its defects may be beneath, where they are not seen. This can be done with a Turquoise.

Transparent coloured stones may be so much the thinner as their colour is more intense, and *vice-versa.*

The colour and brilliancy of a stone is greatly heightened by multiplying the work; that is, by increasing the number of small facets, triangular and four-sided, on the Bizel, and by cutting the Collet-side into steps and ribs as shewn at Fig. 7. The spherical outline as seen at Fig. 8 is also advantageous to colour and brillancy in the case of thin stones. The Table of the Amethyst is often slightly convex. Flaws are also concealed by much work.

Topaz and Colourless Sapphire should be cut in steps, as they then refract more light than a Brilliant.

The Emerald, Peridot, Blue Sapphire, and Ruby, should be cut in small or large steps according to the intensity of their colour, with a low Bizel and large Table, as at Fig. 6.

A Chrysoberyl should be cut as a Brilliant.

The Garnet may be cut like the Emerald, or in almost any form. Abroad it is often cut as represented at Fig. 10. When the colour is feeble, the stone should be mounted on a silver or coloured foil; when intense, it should be hollowed beneath.

The Chrysoprase may have either the Table flat, with a convex Collet-side, or both sides may be convex, as in Fig. 11. The Bizel should be low and cut into facets.

Opal, Avanturine, Cat's-Eye, Moon-stone, &c. should be cut *en Cabochon*, flat beneath and without Bizel.

N.B.—*A Karat* is 4 grains. Thus in Jewellers' language a Diamond that weighs 20 grains is a Diamond of 5 Karats.

The term *line* is frequently made use of in the following pages, when speaking of the size of certain stones. The *line* here alluded to, is the 12th part of a French inch, which is to an English inch as 1 is to 9 tenths.

MINERALS AND THEIR USES.

LETTER I.

Introduction—Attraction and Repulsion—Integrant and Constituent Molecules — Elements — Oxygen — Hydrogen—Nitrogen — Sulphuric Acid — Carbonic Acid — Muriatic Acid — Oxides — Salts—Primary and Secondary Forms of Crystals.

WHEN we consider the mechanism of language and its symbolical arrangement, we are struck with the great facility with which we speak and read and write. The learning of our letters, the connecting of these letters into syllables, the combining of syllables for the formation of words, and the proper collocation of words in the construction of sentences, appeared to our infancy insurmountable difficulties; but we have overcome them, and in a very short time, as regards the complicated system of which these preliminary studies are the foundation. The construction of our native tongue seems to us to be simple, only because it is familiar, and a science appears repulsively difficult, solely because we are unacquainted with its elements. These elements, unfortunately, are ever the most difficult and the most irksome to acquire. Be not alarmed, however, for as I by no means pretend to make you a scientific mineralogist, and have no desire to fatigue your

attention, I shall not attempt to initiate you into a perfect knowledge of the elements of Mineralogy.

In order to vanquish the repugnance we naturally feel to learn the alphabet of any science, we must be first stimulated by a prospect of the pleasure which the knowledge of such science is calculated to afford. If, after you shall have perused these letters, you find your interest in the subject increased, and feel a desire to know all the secrets of nature that are contained in the mineral kingdom, it will then be time enough to learn the science by a systematic study of its elements; nevertheless, as in the mere endeavour to awaken your curiosity, by calling your attention to some of the more remarkable mineral substances, and the most striking facts relating to them, it will be impossible for me, whatever precautions I may take, not to make use now and then of terms which may not be familiar to you, I shall devote the present letter to a few definitions and explanations, that will the better enable you to comprehend those that follow.

Philosophers have observed in the material world two great antagonistic powers, *Attraction* and *Repulsion;* they are, so to say, the sympathy and the antipathy of matter. The first of these powers, or Attraction, is that which draws together molecules of the same or of different natures; in the first case it is called *attraction of aggregation*—by it, the particles of a body, whether simple or compound, are mutually attracted and cohere. The attraction that exists between particles of different natures is called *affinity*, a power commissioned to operate unceasingly those wonderful metamorphoses, by means of which

the leaves of the mulberry-tree are converted into silk, the juice of the grape into nectar, alum and lime into sapphire, æriform substances into fluids and fluids into solids; in a word, it is by the play of affinities that minerals are changed into vegetables, and that the fruits of the earth become transformed into animal substances. Matter is indestructible, and corruption but the first step towards a new transformation. The seed perishes only to resuscitate in the form of a flower, the flower fades but to change into fruit.

You were ever fond of flowers, and when, besides the beauty by which they are distinguished, you fancied you discovered in them an exquisite sensibility, they became the objects of your predilection and of your anxious solicitude. From that time you studied to divine their wants, and supplied these with tender care. They live, said you, they feel; they have their infancy, their maturity, their decrepitude; they are subject to sickness and death, it is impossible not to take a lively interest in them; but stones, however pretty they may be, are mere insensible matter. My pretty cousin, you know not these *stones,* as you contemptuously call them; allow me therefore to initiate you into the secret of the sensibility, if I may so call it, of minerals, for though, as inorganic substances, they do not exhibit those stages of successive existence which we observe with so much interest in the animal and vegetable kingdoms, still are they governed by laws well worthy of attention.

I have already assimilated attraction and repulsion to sympathy and antipathy, and indeed repulsion and the attraction of aggregation and of affinity bear a

striking analogy to moral feeling. Simple substances seem to feel towards each other aversions, friendships, and affections; and, what is yet more remarkable, these sentiments are ever mutual. The particles of two different bodies are mutually repelled, feebly attracted, or so strongly united as not to be separated without difficulty. Those that are but slightly attached break off the connexion as soon as either of the two meets with a more congenial companion; it then leaves, so to say, the mere casual acquaintance to cling to the friend.

Thus, I trust, I have in some degree vindicated mere matter from your reproach of insensibility, and raised it in your estimation.

Independent of the antipathy of certain substances to a connexion with others, there is one which, if it could, would keep them all for ever disunited, this great repulsive force is called *Caloric*, supposed by some to be a fluid of infinite rarety, but which, in fact, is known only by its effects; it insinuates itself between the particles of bodies and urges them beyond the sphere of their mutual attraction.

As a striking instance of attraction, I will mention the strong affinity exhibited by Potassium and Oxygen, the former being never found but united with the latter. For many centuries the compound was considered a simple substance, under the name of Pure or Caustic Potash. The scrutinizing eye of modern science, however, discovered the truth. Davy, calling to his assistance the power of galvanism, effected their separation. Potassium is a white and beautiful metal, while Oxygen is the most energetic of material substances. The latter may be

likened to a vain, inconstant youth who, conscious of his importance, forms companionships often without attachment, which he quits without regret for new connexions. His greatest predilection, however, is for Potassium, and not without reason; for such is the ardent attachment of Potassium for this flighty and capricious being, that he seizes him wherever he finds him, and should this happen to be in certain company, as for instance with Hydrogen, his jealousy knows no bounds; heedless of *éclat*, he literally sets fire to water, and in the midst of the conflagration vanishes from sight with this beloved friend. But, to leave all metaphor—such is the affinity of Potassium for Oxygen, that when the former is thrown upon water, it seizes the oxygen of the latter with such avidity that the mass inflames, and being dissolved by the water, disappears.

I have spoken to you of *integrant molecules*, for such is the name given to those infinitely small particles which are of the same nature as the mass they form. Such, for instance, are the particles of pure chalk, every one of which is of the same nature, and has the same properties as the mass. Integrant molecules are either simple or compound, as they consist of one or more elements. The particles of a compound substance are called its *constituent molecules,* and in such a substance there are both integrant and constituent molecules; whereas in a simple body, such as a metal, there is but one kind of molecules, or rather the integrant and constituent molecules are the same.

By *elements* are understood such bodies as are considered simple, that is to say, those which have

never yet been decomposed, and which are accordingly supposed to be formed of only one kind of constituent molecules. The ancients, as you know, reckoned four elements, Water, Air, Fire, and Earth; but modern discovery has proved that water is not an element or simple body, but in truth a compound one; its constituent elements are two gases or æriform substances, of which one is called *hydrogen,* and the other is the *oxygen* already mentioned. Air is also a compound body, composed of the same oxygen and *nitrogen.* The nature and properties of these gaseous substances or æriform fluids belong to Chemistry; and I would not here touch upon them were it not, that Mineralogy having borrowed assistance from the language of Chemistry, it is indispensable that you should understand the meaning of a few chemical terms.

Thus those bodies which are composed of oxygen and any other substance, called the *base* of such compound, are said to be *oxidized.* Of these some are acids, such as *Sulphuric Acid* (vitriol), which is composed of sulphur and oxygen; *Carbonic Acid,* formed of carbon and oxygen; *Muriatic Acid,* which is obtained from common salt; and many others. All the three kingdoms furnish us alike with bases which, by combining with oxygen, acquire acid properties; the number is accordingly very considerable. Those compounds of oxygen with a base which have no acid properties, are simply termed *oxides:* in this class are ranged Air and Water. The rust of iron is also an oxide, and that bright pigment which you use in your paintings, and know by the name of Minium, is an oxide of lead.

Whenever an acid combines with an *earth*, an *alkali*, or an *oxide*, the result is a *salt*. But as late discoveries have shewn that the earths and alkalies themselves are metallic oxides, it will be more correct to say that a *salt* is a compound of an acid and an oxide. Thus that beautiful green colour (of whose use in painting I would caution you, as it is a strong poison) verdigris, is a salt formed of acetic acid and the oxide of copper. In like manner that splendid mineral, Malachite, is a salt formed of the same metal and carbonic acid. Marble is also a salt, being a combination of carbonic acid and the oxide of calcium (lime).

In the mineral kingdom, the diamond, sulphur, and the metals, are the only simple bodies; all others are more or less compounded of metallic oxides, earths, and salts, sometimes merely aggregated, and at others intimately combined. A great many of them crystallize, that is, assume regular forms, some of which are very complicated and many very beautiful. I will not, however, enter upon the laws of Crystallization, as it would lead us much too far, and most probably appear to you dry and unattractive. There is, however, one fact which you will do well to remember, viz. that the form, whatever it be, of the integrant molecule, is ever the same for the same substance, whatever diversity there may be in the form of its crystals. This may seem to you somewhat paradoxical; but you will at once perceive its possibility when I explain to you, that two forms are employed by nature in the constitution of a crystal, the one called *primary* or *primitive*, the other *secondary*. The primary form is that assumed

by the integrant molecule; now, according as other molecules of the same form are diversely arranged on this nucleus, they necessarily produce a mass whose shape is very different from that of each of the separate molecules, and this shape it is which is called the secondary form. If the integrant molecules were not infinitely small, their aggregation would exhibit a mass with a rough surface and jagged edges, but such is the extreme tenuity of the molecules, that the faces of the crystals appear as smooth, and the edges as sharp, as if they were cut and polished by the lapidary.

Besides the crystalline forms, minerals assume many others, more or less regular, which we shall have occasion to notice as we proceed. Those that have no regular shape are said to be *amorphous;* but I must now conclude the present letter, much less interesting than I could wish it to be, but the utility of which you will acknowledge as we advance.

LETTER II.

Salts — Muriate of Ammonia — Sub-carbonate of Potash — Saltpetre—Culinary Salt—Houses built of Salt—Salt-mine of Wieliczka — Kelp—Barilla—Borax—Natron —Ahmulahs of Abyssinia—Superstitious ideas attached to Salt.

YOU will have learnt by my last, that what is called a *salt* is the compound of an acid and an oxide, the meaning of which terms were also explained. I shall now speak of some salts in particular.

Salts are divided into Alkaline, Earthy, and Metallic; for although certain Alkalies and some of the Earths are found to be metallic oxides, and are all suspected to be so, still we continue to call ammonia, potash, and soda, *Alkalies*, and lime and magnesia, *Earths*. Alkaline salts, then, are those in which ammonia, potash, and soda, form the bases.

AMMONIA or *Volatile Alkali* in the gaseous state is composed of hydrogen and nitrogen; it extinguishes flame, and quickly destroys the life of any animal who should breathe it: dissolved in water, its volatility is somewhat diminished: with Alcohol (spirits of wine) it forms the compound so well known to our worthy grandmothers under the name of *Spirit of Hartshorn*. Ammonia is procured from all sorts of animal and vegetable matters in a state of putrefaction, but principally from the distillation of bones, horn, and other animal substances.

The *Volatile Sal Ammoniac*, so essential to our exquisites when accompanying a lady of delicate

nerves to some sentimental drama, is a compound of carbonic acid gas and ammoniacal gas. These two æriform substances, on uniting, form that solid white salt contained in the smelling-bottle, that dear Horatio presents to the olfactories of Lydia, whom the piercing shriek of Fatima, in *Bluebeard*, has thrown into a state of syncope. She, poor unconscious soul! little dreaming that her attentive friend is making her inhale what proceeds from the rubbish of the stable.

United with muriatic acid, ammonia forms the salt known as *Sal Ammoniac*, simply. It is much used by dyers, as also for tinning copper and iron, and in soldering. It is likewise used in medicine. The celebrated eau-de-luce, so much valued in tropical countries as an antidote to the poison of venomous reptiles, owes its virtues to the ammonia that enters into its composition. This salt is found, naturally formed, in the environs of volcanoes, and in Persia, Turkestan, Tartary, Siberia, &c., in the state of an efflorescence. In Europe a great deal is prepared; the methods employed varying in different countries. Formerly, Egypt alone supplied the whole of Europe with this substance, whose name is derived from that of Jupiter Ammon, near whose temple it was first prepared.

Potash is a *fixed Alkali* procured from vegetables, whence its name of fixed *vegetable* Alkali. All plants furnish it, but some more than others. The vine, wormwood, thistles, potatoe-stalks, &c., contain a large quantity. The plants from which it is obtained are well dried, then burnt, and water poured upon the ashes; these are then stirred up,

and a sufficient time being allowed for the water to dissolve the salts contained in the ashes, it is drawn off clear and evaporated, either spontaneously or over a fire. What remains after this process is the potash of commerce, which is a subcarbonate, and, in the state just described, is very impure, being mixed with other salts, contained in the vegetables employed, or formed during the processes through which they pass.

Potash is an object of great importance. With nitric acid it forms Saltpetre, so eminently useful in the hands of conquerors for checking the over-population of the earth; but it is also applied to more legitimate purposes. It is used in the manufacture of glass, to form which it is mixed with sand; and thus it is that we are indebted to the most worthless of soils and the briers that grow upon it, for the means of interrogating the heavens and making acquaintance with the microscopic world. The uses of glass are far too numerous to be detailed; what your sex could do without it would be hard to say, as clear fountains are not always at hand to supply the place of mirrors. I am indebted to it for preserving the speaking likeness of my pretty cousin, without concealing it from my sight. Potash enters also into the composition of alum, soap, Prussian blue, &c.

Although this substance is obtained in a large way from the vegetable kingdom, it is also found among minerals, united to nitric acid; which compound, as I have already said, is our saltpetre or nitre. This salt is met with as an efflorescence on the surface of the soil in many parts of the world;

but as the consumption of it is very great, art is employed in aid of nature to increase the quantity. Old plaster and rubbish is mixed with vegetable matter, and moistened with the liquor of the stable-yard, &c. The mass is left to rot in the open air; it is then washed, and the liquor filtered and crystallized. The nitre thus produced, however, is very impure, and is therefore submitted to various purifying processes, which are foreign to our subject.

Nitre is of great use in medicine: in hot countries it is employed for cooling wine and other liquors. It is said, that about two-thirds of the immense quantity of nitre supplied by the East Indies is employed by the Chinese for their fireworks; which, we are told, are beyond description magnificent.

Having thus told you something of Ammonia and Potash, I will now say a word on *Soda.* This alkali, in contra-distinction to the last-mentioned, is called the Fixed *Mineral* Alkali. This distinction however is not strictly correct, for we have seen that Potash exists in the mineral as well as in the vegetable kingdom; and Soda, in like manner, belongs to both, as we shall presently see.

Soda, by uniting with a variety of acids, forms a variety of salts; but I will speak to you of that one only which is the most extensively used, and which therefore interests us most. Culinary or common salt is a compound of Soda and Muriatic Acid. It is very extensively distributed over the earth under various aspects. The Ocean is its great reservoir, where it exists in solution. The quantity of saline ingredients contained in the sea, says a deservedly-popular writer (the late Mr. Mudie),

amounts to 400,000,000,000,000,000 (four hundred thousand billions) cubic feet, which, if piled into a single cube, would form a mass 140 miles long, as many broad, and as many high; or, otherwise disposed, it would cover the whole of Europe—islands, seas, and all—to the height of the summit of Mont Blanc, which, as your Geography tells you, is somewhere about 16,000 feet high. The whole of this enormous mass of salt however is not the Muriate of Soda, for other salts exist also in the sea; it nevertheless forms by far the greater portion of the mass. Besides the sea, there are salt lakes, though these are comparatively small in number. On the other hand, salt springs are very common. They are found in almost every country of Europe, as also in Asia, Africa, and America. In several places salt is found in large masses, either hidden at great depths in the earth or at the surface, or forming hills of considerable height: sometimes it is met with as an efflorescence.

Near Montserrat, in Spain, is a hill or mass of compact salt, without vein or fissure, of the height of 500 feet and 16,000 in circumference. At Lahore, in India, there is a similar hill. Elphinstone, speaking of a place in the country of the Affghans, says, "The road was cut out of solid salt, at the foot of cliffs of that mineral, in some places more than 100 feet high above the river." The island of Ormuz, at the entrance of the Persian Gulf, is a rock of salt. Chardin tells us that the rock-salt of Kirman is so hard, that it is employed like stone for constructing the houses of the poor. In Moldavia the salt forms eminences, and in the Lybian desert it is

seen at the surface of the soil. In Persia there is a great desert, 130 leagues long and 70 wide, where salt, in the state of an efflorescence, covers the ground like hoar-frost. It presents itself in the same manner in some parts of India, in Thibet, and in China. Gem or Rock-salt is that which is found in mass in the bowels of the earth; it is of various colours, as red, blue, violet, brown, and even green; generally however of a dirty grey; though sometimes as white and beautiful as rock-crystal.

You have probably heard of the celebrated salt-mines of Wieliczka in Poland, the description of which has been greatly exaggerated by the generality of travellers; but Mr. Brard, whose account of them is much more faithful, and agrees exactly with that of Townson, describes them thus: "The workings in these mines consist of three stories, each of which corresponds to a bed or stratum of salt. The first of these workings is at 200 feet below the surface, and the third and lowest at a depth of 740 feet—some travellers have said a 1000. The salt at this deepest working is the purest, and no other is at present extracted. This working extends over a distance of nearly half a league in length, and almost a quarter of a league in breadth: it consists of galleries and chambers of great height, wholly excavated out of the salt; the roof being supported, where necessary, by pillars of this substance, left for the purpose. Some of these chambers are said to be from 180 to 300 feet high." The salt is extracted by means of wedges and levers, and by blasting with gunpowder, (perhaps now replaced by the gun-cotton, of which you have no doubt read the ac-

counts). From the huge masses thus detached, the purest is shaped upon the spot into cylinders three feet high, and two and a half in diameter, and which, under the name of *Balwāns*, are exported, whereas the chippings are reserved for home consumption. Twelve shafts are kept open for the service of the mines; that is, for the extraction of the salt, and the passage up and down of the miners. The communication from the upper to the lower workings is effected by means of wooden stairs of easy descent. One of these flights of stairs is reserved for visitors of distinction.

These mines give employment to from twelve to fourteen hundred workmen and forty horses, which latter are employed in the interior of the mines, where they remain for six or seven years, without experiencing any other inconvenience than that of becoming totally blind. The air, which circulates freely in these vast caverns, is pure and dry; the miners enjoy robust health, and the wood-work remains sound for a very long time. These mines have been worked ever since the sixteenth century, (Patrin says since 1251). They produce annually 150,000 hundred-weight of salt. Some travellers have asserted that there exists in the mine an entire village; and that the miners, with their families, pass their whole lives there without ever seeing the light of the sun, &c. The simple fact is this: There exists in the first or upper story a chapel, wholly sculptured out of the salt, and dedicated to St. Anthony. This chapel is 30 feet long, by 24 in breadth, and 18 in height; the altar and steps, the candelabra and other ornaments, the twisted columns

that sustain the roof, the pulpit, the crucifix, and the statues of the Virgin and of St. Anthony, are all sculptured in salt, as is also a statue of Sigismund, King of Poland. There are also two other chapels of a similar kind, in which Mass is performed to the sound of trumpets and cymbals on particular days of the year, in commemoration of certain phenomena which occurred in the mines in former times. Stables are constructed for the horses, and closets, in which the workmen can lock up their tools when they come up from their work, which they do every day. There are in the mines several lakes, which may be navigated in boats; and, upon the whole, and without any exaggeration, these mines have a magical and imposing aspect, from the vastness of the excavations, and the brilliancy of the walls, of the roof, and of the pillars which support it.

Such then, my dear Florence, are the famous Salt-mines of Wieliczka. When they are visited by persons of distinction, the chapels, the galleries, and the vaulted roofs, are illuminated with innumerable torches, the light of which, refracted in all directions, produces a most splendid effect. There is in the mine itself, and close to a spring of salt water, one of fresh water, of excellent quality, which is used for the horses. In our own country a similar mine exists in Cheshire, but without the chapels, &c.: much of the salt in this mine is red; the deposit is of great extent; it is said to yield 16,000 tons of salt per annum for home consumption, and that 140,000 tons are annually exported from Liverpool. For an interesting description of the salt-mines of Northwich, I must refer you to Sir George Head's

Tour through the Manufacturing Districts of England in 1835.

Salt crystallizes in cubes: and beautiful groups of this form are found adhering to the woodwork in parts of the mines where water has had access to the salt. At Wieliczka they manufacture small vases, little boxes, statuettes, &c., of the pure white rock salt, which look like works in crystal; they must, however, be kept in dry places, for salt is highly hygrometric.

I have already observed that the terms *vegetable* and *mineral* Alkali were incorrect, inasmuch as both Potash and Soda belong to both the vegetable and mineral kingdoms. Thus soda as well as potash is extracted from many plants by incineration and lixiviation. These plants are different species of salicornias, chenopodiums, sea-weeds, &c. The ashes of these plants form what is known by the names of *Kelp* and *Barilla;* though the latter is properly the Spanish name of one of the plants itself, the *Salsola Sativa*, from which the salt is obtained. The best barilla comes to us from Alicant in Spain; but kelp, which is obtained from the coarser kinds of sea-weed, sometimes called *rock-weed,* is prepared in the Orkney Islands and other parts of Scotland to the amount of many thousand tons annually. It is however poor in soda as compared with Barilla, the former yielding but about two or three per cent., while the latter gives from twenty to thirty. So important is the Barilla trade considered by the Spaniards, that they had, and perhaps still have, a law prohibiting, under pain of death, the exportation of the seed of the plant whence it is procured.

The uses of soda are much the same as those of potash. The Egyptians used it in preparing bodies to be embalmed, leaving them in it for sixty-and-six days; thus doing for the bodies of Cheops and the other Pharaohs what we do for our pigs.

Soda united to Boracic acid produces the salt called *Borax*, from its Arabian name Baurach. It comes to us from India in an impure state under the name of *Tinkal*. It is of great use to the goldsmith and jeweller for soldering the finer objects of their art. It is also employed as a flux for the colours and the gold that are applied to porcelain.

With carbonic acid Soda forms *Natron*, of which there are extensive lakes in Egypt, that are of much importance to that country. By the ancients Soda was called *Nitrum* or *Natrum*, from the town of Nitria, near which the natron lakes were situated. The Nitrum of Pliny was a *Carbonate of Soda*, whereas our Nitre, as I have already explained to you, is a *Nitrate of Potash*.

The Alkaline Salts, then, are of great importance, more particularly our common salt, which has always been an object of primary necessity: it has, moreover, been used by different people, and is even now used by the Abyssinians, as a medium of exchange, answering the purposes of money. For this object it is shaped into pieces nearly resembling in size and form the stones used by mowers to sharpen their scythes. These pieces of salt are called in the country Ahmulahs, and about twenty of them are valued at an Austrian dollar. Almost every nation has some superstition connected with salt. It was the symbol of friendship, by reason, it is conjectured,

of its preventing corruption and destruction, with which evident meaning Christ in the Scriptures calls his disciples the *salt* of the earth, as preserving men from the corruption of the times. The priests of Egypt never allowed it to be placed on their tables, regarding it as the spume of their great enemy Typhon. In our own times it is used in many religious and political ceremonies. One of our proverbs says, "We must eat a peck of salt with a person before we can know him." This, my dear Cousin, we have not done, and yet I am sure you know me well enough to be assured of my sincere friendship.

LETTER III.

Earthy Salts—Alum—Magnesia—Barytes—Strontianite.

IN the present letter, my dear Florence, I propose giving you some information on the Earthy Salts, having in my last spoken of the Alkaline Salts. The Earthy Salts are those which have for their bases, Alumina, Magnesia, Lime, Baryta, and Strontia.

Of all these, those which have lime for their base present the greatest variety of appearances and are the most universally distributed over the globe. I shall therefore reserve what I have to say regarding them for my next letter, which will probably be a long one, as they form an extensive and interesting subject, and shall confine myself at present to the others, beginning with—

Alum.—This mineral, so well known to every one for its peculiarly sweetish acid and astringent taste, is called a triple salt, being a compound of Sulphuric Acid, Alumina and Potash; or, in place of the latter, Soda, Ammonia, or Magnesia.

Alum is sometimes already formed by nature, but more frequently it is prepared from certain rocks which contain its principal ingredients. In the native state it is rarely massive, though we are told that in Egypt there exists a vein of it from three to fifteen inches thick, which is worked. It sometimes forms an efflorescence, and sometimes occurs in white silky filaments intersecting slaty or volcanic rocks, when it is called *Plume*, or *Plumose Alum*. It is likewise found in certain peats, and in

solution in springs. There is also a kind which, in the form of a pasty exudation, occurs in the cavities of some schistose mountains, and which has been called *Rock Butter*. But native Alum is usually disseminated in the rock which furnishes it. Such is the case at Tolfa, near *Civita Vecchia,* in Italy, from which place we get the purest kind, known as *Roman Alum*. The process of extracting it is very simple. The rock is calcined, broken and lixiviated, and the solution filtered and evaporated.

The rocks containing native Alum are easily recognized by their taste, after being slightly calcined. They were known by the ancients under the name of *Sarcophagus Stone*, from their possessing the property of destroying dead bodies.

The process of obtaining Alum from the rocks that contain only the necessary ingredients for its formation, is more complicated, and is entirely chemical. I would not, therefore, describe it to you, were it not that it offers an interesting example of that play of affinities of which I spoke to you in my second letter. I will, therefore, endeavour to describe it in a way you will easily understand.

All the clays contain Alumina, and several of them, especially certain slates, also contain pyrites, a compound of Sulphur and Iron, of which I shall have occasion to speak more fully hereafter. These aluminous slates, then, contain the principal ingredients of Alum, Sulphur and Alumina; all that is necessary is the conversion of the former into Sulphuric Acid, which then combines with the Alumina. To effect this the process is as follows:—

The slate extracted from the quarry is exposed in

heaps to the action of the air and rain for a longer or shorter period, sometimes extending to two years, during which the pyrites decompose. The oxygen of the air unites with the sulphur and forms sulphuric acid, a portion of which seizing the iron, which is in the state of an oxide, forms with it sulphate of iron, or green vitriol, (sometimes called *copperas*, though it does not contain a particle of copper,) while the rest combines with the Alumina to form Sulphate of Alumina. The two salts then shew themselves in the form of an efflorescence at the surface. The stone is next calcined, in order to render the metallic salt insoluble in water. This operation, together with the cooling, requires three or four months, after which the whole is lixiviated in the same way as for the rocks containing native Alum, with this difference, that Potash is added. The solution, properly filtered, is then evaporated, when the Alum crystallizes and is ready for consumption. There are other and more direct and expeditious methods for preparing Alum, but they are foreign to our purpose.

The quantity of Alum supplied by nature or obtained by art is very great, and proportionate to the multifarious purposes to which it is applied. It is used by dyers for fixing and giving brilliancy to their colours; it is also necessary in the preparation of leather, and in the making of candles, to which it gives firmness. Paper-hangers mix it with their paste to keep away mice, and it is mixed with glue to preserve it from worms. It prevents paper from drinking the ink, and renders both it and wood almost incombustible. If Alum and common salt

are reduced to an impalpable powder, and mixed with spirits of wine, and several coats of this be laid upon the skin of the hand, a red hot iron may be held without inconvenience. This, in fact, is the secret of the human salamanders, or incombustible jugglers, fire-eaters, &c. A small pinch of Alum thrown into a vase of turbid water will quickly cause the impurities to subside: this is a very common practice in India. Bakers use it in order to render their bread whiter and lighter than it would otherwise be. In medicine it is used as an astringent; but its applications are much too numerous to be here detailed, I will, therefore, only add on this subject, that Alum is said to be so compact and hard at Beregh, in Hungary, that it is employed in the construction of millstones.

Alum crystallizes in regular octahedrons or double pyramids, frequently with their edges bevelled, and their solid angles truncated. This facility has been taken advantage of for the formation of those pretty baskets and other toys which you have seen in our bazars. The basket is formed of wire, and suspended in a saturated solution of alum, coloured blue with indigo, or otherwise. The wire, in a short time, becomes covered with crystals of a beautiful blue, like so many sapphires. As alum is not a deliquescent salt, these baskets retain their form and beauty for a long time.

The best Alum, I have said, is the *Roman Alum;* that called *Roch Alum* derives its name from the town of Roccha, formerly Edessa, in Syria, where the earliest alum-works were established.

All these details, you will perhaps say, are very

uninteresting. I agree with you that there are more interesting subjects; but you required of me some positive notions of mineralogy. If my letters have not the charms of those addressed to Emilie or to Sophie, you will be pleased to remember that the subject of the former was mythology, an eminently poetical subject, and that those to the latter afford but little solid instruction. In these letters, though I shall avoid the abstruse details of my subject, you must not expect that I shall enliven it with the extraneous ornaments of insipid compliments, or unconnected episodes. When you find my prose dull, you may seek recreation by turning to analogous subjects, poetically treated, in the works of Darwin and Delille.

Supposing, then, that you have been refreshed in some of the sparkling caverns of the Gnomes of Darwin, we will return to our more sober lessons. I will now speak to you of a substance, the taking of which in your infancy probably caused you as many grimaces as you may now make in reading about it. But I will say, as your nurse did, wry faces or not, My dear, you must take the dose; and I will add, by way of encouragement, it will soon be swallowed.

MAGNESIA is united sometimes to Sulphuric, and sometimes to Boracic Acid. The sulphate is found only in a state of solution, or as an efflorescence. It is to this salt that the waters of Epsom, of Sedlitz, and of Egra, in Germany, owe their medicinal properties. It easily crystallizes in four-sided prisms surmounted by a pyramid.

Boracite, or the Borate of Magnesia, is a very hard substance, which has hitherto been found only

in the form of cubical crystals, either transparent or opaque. It exhibits the singular property of becoming electric by heat; one of the diagonally opposed solid angles attracting, while the other repulses. Kalkburg, near Luneburg, and Kiel, in Holstein, are the only places where this mineral has been found.

Magnesia turns vegetable blues to green. Foul water, shaken up with a little magnesia, soon loses its bad taste and smell. Let us now pass on to another substance, which I shall endeavour to treat as lightly as possible, for it is of its own nature so heavy as to have received the name of Heavy-spar. It is the Barytes of the mineralogist, so called from the Greek word signifying 'heavy.'

The Earth Baryta, by combination with Sulphuric Acid, becomes the Sulphate of Baryta. When this substance is fused by the blowpipe, it communicates a green colour to the flame. It melts into a globule of white enamel, which, a few hours after, crumbles into powder. This globule, if placed upon the tongue, has a strong taste of rotten eggs. Now, methinks I hear my pretty cousin exclaim—"Really this mineralogy is somewhat repulsive. Smelling-salts formed of heaven knows what,—Magnesia and rotten eggs! I expected to hear of diamonds and rubies, and all other pretty stones, and of marbles and porphyries, and such like beautiful productions" —and so you will in due time; but as I know you would not like altogether to be treated as a child who is only interested in what pleases the eye, I shall make bold to proceed.

The Sulphate of Baryta exhibits a very curious property. If, after being recently calcined, it be

taken into a dark room, it exhibits a reddish light. This mineral is found both transparent and opaque, and of different colours and forms; its crystals, which are so large as to be sometimes found weighing half a cwt., are generally very perfect and flat, or in tables, with bevelled edges; sometimes it crystallizes in long prisms, as is the case with the masses found embedded in the Fuller's Earth, near Reigate in Surrey. It is also met with in star-formed agglomerations near Bologna, in Italy, whence this variety is called *Bologna-stone,* and at the Isle of Sheppey, and elsewhere. These agglomerations were formerly called *Lepidastra.* It is this particular variety which is so remarkable for its phosphorescent property, and is indeed the most anciently-known phosphorescent body. From it is prepared a substance known as Bologna Phosphorus, first discovered by Casciavole, an Italian cobbler. In order to prepare it, the stone is calcined and pulverized, and, being mixed with gum-water, is formed into little cakes; these, after being exposed to a vivid light, and taken into the dark, give out the light which they seem to have absorbed, and shine even under water.

There is a variety of the Sulphate of Baryta which represents, in a rough way, the convolutions of the intestines, and is known by the name of *Tripe-stone,* beautiful specimens of which are found in the mines of Wieliczka and of Bochnia; there are also compact and earthy varieties, but the latter are rare. In the silver mines of Kongsbergen, in Norway, a fetid Sulphate of Baryta is found, which, upon being heated or rubbed, emits a very disagreeable odour. Barytes is rarely found in mass,

usually it is in veins, which are often rich in metallic ores.

The uses of this mineral are limited and unimportant. It is sometimes employed as a flux in the reduction of certain ores, and it is asserted that the Chinese make use of it in the preparation of a particular species of porcelain. As a pigment it forms a permanent white.

Baryta is also susceptible of forming a compound with Carbonic Acid; but the Carbonate is rare, and has no other use, that I know of, than as a poison for rats. Baryta changes vegetable reds into violet or blue, and yellows into brown.

The next and last substance I shall mention in this letter is Strontianite, so called from Strontian, in Scotland, where it was first discovered. It forms with sulphur and carbonic acid, salts very similar to those of Baryta. The subject of Lime I reserve for my next.

LETTER IV.

Lime—Variety of forms of Carbonate of Lime—Fluor-spar—Murrhine Vases—Engraving on Glass by Fluoric Acid—Fanciful Application of Fluor-spar—Sulphate of Lime—Plaster of Paris — Selenite — Satin-spar — Alabastrite—Alabaster, mode of its formation—Stalactites and Stalagmites—Caves of Antiparos and Castleton—Lachrymatory and Cinerary Urns—Bones and Teeth.

IF the variety of mineral substances is great, the diversity of forms and aspects assumed by the same substance is still more remarkable. You will, no doubt, be surprised to learn that those imposing masses of dark and rugged rocks, piled one upon the other, which give so much picturesque effect to the romantic sites of the Cantons of Zurich, of Soleure, and of the Pays-de-Vaud, and of many beautiful spots in our own most beautiful island—that the white and almost diaphonous substance employed by Praxiteles to hand down to an admiring posterity the lovely forms of the graceful Phryne, under the name of the Guidean Venus—that the pastils which enable you so perfectly to represent the virgin whiteness and elegant contours of the lily, that most majestic of flowers—that the chaste pearl supplied by the shell of Manaar, which you prefer to diamonds, and which the fascinating Cleopatra, in the sheer wantonness of extravagance, converted into a most costly beverage, are nothing more than Lime and Carbonic Acid. Yes, my dear Florence, the frowning rocks of Jura and the Vosges—the beau-

tiful marble of Paros and Carrara, the sterile chalk of the Champagne Pouilleuse and of our own Downs —the roseate pearl and the brilliant coral, are all one and the same substance, under a variety of aspects.

Thus playful Nature varies her productions, reserving, however, her most ingenious handyworks for her more devoted admirers. For the multitude she rears conspicuous those imposing masses, which command respect and inspire dread of her power; but she works in secrecy and in darkness to reward her favourites. The chasms of the blackest and most rugged calcareous rocks are lined with white and more or less transparent crystals, cut and polished into brilliant facets, which the lapidary's art may imitate, but cannot surpass. You would hardly believe it possible, that these rocks and the crystals they contain, are one and the same substance; but your surprise will, no doubt, be increased when I inform you that, with the same elements of which they are both composed, and on a nucleus of a constant primitive form, there are more than seven hundred different secondary forms of crystals of calcareous spar!

Limestone-rocks, moreover, contain immense caverns. In these vast, dark, and silent recesses, Nature, assisted by Time, fashions groups of stalagmites of the most varied and singular forms. Pyramids, columns, arcades, altars, organ-pipes, statues, busts, vases, flowers, and light moss; while she suspends from the roof culs-de-lampe and tassels, and draperies of snowy whiteness, looped up with grace. These objects, continually varying in size and appearance as fresh matter is deposited upon them, eventually fill up the cavern, and convert it into a

deposit of Alabaster; a substance well known to the ancients, and of which I shall presently speak.

Nature seems to have chosen the calcareous rock in preference as a cabinet for her medals of the Antediluvian World. It is principally in what is called the fossiliferous limestone that are found the remains of a great number of organized bodies, the like of which are no longer living upon our planet. These undeniable testimonies of a former order of things at the earth's surface, different from the present, were for a long time regarded merely as a proof of this one fact; but the persevering researches of the present day seem to afford evidence of many changes, and, by enabling us to trace something like successive formations, have raised Palæontology to high consideration, and greatly assisted the practical geologist; though, I regret to add, they have also contributed to the conversion of a very useful branch of knowledge into a labyrinth of cosmogonic hypotheses. But, to return: a beneficent Providence, then, supplies us with the same substance in every form necessary for the satisfaction of our wants, for our instruction, and our pleasure; and human sagacity, a much richer present of the Creator, has turned the gift to good account. Thus limestone and marble are employed by us in the construction of our basilicas, our temples, and our most magnificent edifices; and the same material furnishes the cement which consolidates the work. From shapeless blocks of marble, struck by the hand of genius, have sprung the Belvidere Apollo, the inimitable Laocoon, and that host of admirable Greek statues, for whose animation the Promethean fire is alone wanting.

Under the form of Chalk, Carbonate of Lime is employed in a great variety of arts. By its means wood is covered with gold to adorn our altars, to decorate our habitations, and to frame, in a fitting manner, the sublime productions of our painters. The same substance again, formed into pearls by the zoophite, in his rainbow-tinted shell, decks the crown of kings, and adorns the neck of beauty. The Polypus builds with it his palace of coral, and the Argonaut constructs with it the light skiff in which he skims the surface of the waves.

Fluate of Lime.—Do you remember the admiration you expressed at the large group of fine green crystals you took for emeralds in the collection of our friend B—, and which he then told you was a variety of Derbyshire spar? Well, then, this beautiful production of nature, which assumes not only the colour of the emerald, but which also imitates that of the sapphire, the topaz, and the amethyst, is still lime; but, combined with *Fluoric Acid*, is called *Fluor Spar*, or the *Fluate of Lime*. This production, still greatly esteemed for the variety and disposition of its colours, was scarce and but little known to the ancients, and it was consequently highly valued. It would appear, however, that then, as well as now, it was formed into vases, for it is asserted that the celebrated Murrhine vases, about which there have been so many conjectures, were in reality of Fluor Spar. The first six of which we have any account, were taken from the treasures of Mithridates, and placed by Pompey in the temple of Jupiter in the Capitol. After the defeat of Antony and Cleopatra, Augustus carried off from Alexandria a Murrhine

vase as the most precious of his trophies, and which also was deposited in a temple. Nero, it is said, gave for a single cup of this kind three hundred talents, (upwards of £40,000 of our money). Now that this substance has become more abundant, the price of the finest vase hardly exceeds ten guineas, though I am informed there is one in Derbyshire for which £400 has been asked. The time may perhaps come when these articles will again rise in value, if it be true, as is asserted, that good specimens of the spar of large size are becoming scarce.

The crystallized masses of Fluor Spar usually present but one colour, if we except a particular variety which appears blue or green, according to the position in which it is viewed. But the colour, whatever it may be, of the crystals is usually pure, and their most usual form is the cube. The amorphous masses, on the contrary, present several colours and different shades of these disposed in wavy bands, and blending in the most agreeable manner. The predominating tints are amethystine, which art can change into an aurora-red.

Although this substance is susceptible of receiving a good polish, it is very far from possessing the hardness of the gems whose colours it assumes. It is even scratched by rock crystal; but as a compensation for this relative weakness, the fluoric acid, when separated from the lime, dissolves the crystal.

The corrosive properties of this acid were accidentally discovered by Henry Swanhard, of Nuremberg, from some of it falling on his spectacles, which it corroded; and by him it was employed for engraving on glass, in 1670. In our own day it is occa-

sionally used, not only for graduating the glass tubes and measures used in the laboratory, but ladies employ it for tracing upon glass, designs which are as durable as the glass itself. As its action upon the skin, however, is very energetic, I would not recommend to my pretty pupil to attempt an art, the practice of which might be attended with serious accident, or, at least, the disfiguring of her delicate fingers with unsightly scars. This same fluor spar has another remarkable property, which you may turn to account without danger.

The Fluate of Lime is phosphorescent by heat, and in a darkened room it shines with a very beautiful coloured light. If then you have the iron stove of your boudoir studded in any fanciful manner, as, for instance, in the form of a wreath of leaves and flowers with various coloured pieces of fluor spar, you will have a pretty object in the day-time, and when at night your lamp is extinguished, the garland will show with a soft and exquisitely beautiful effect, of which you may form some idea by pounding some of the green Derbyshire spar, and placing it in the dark on a heated shovel.

Sulphate of Lime.—Lime united to Sulphuric Acid forms opaque gypsum, transparent selenite, chatoyant spar, and diaphanous alabastrite. It is found of various colours, but these are usually dull, and also white. The first-mentioned of these substances, commonly known as Plaster of Paris, from its being extracted in large quantities at Montmartre, near that capital, enables us to make innumerable and faithful copies of the admirable works of ancient sculpture, and thus at a trifling expense to enjoy

the contemplation of the most graceful forms, and the finest compositions.

SELENITE, so called from its moon-like lustre, is perfectly transparent, and susceptible of being split into inconceivably thin plates; it served in ancient times the purposes of glass. The hothouses of Tiberius were covered with Selenite, and Pliny informs us that the curious were wont to observe the labours of the bee in hives of this substance. There exists in the British Museum a most splendid group of Crystals of Selenite, presented to this national repository by H. R. H. Prince Albert. It is worth going to see, if there were nothing else.

SATIN SPAR.—Chatoyant or Satin-spar is a fibrous gypsum. It is employed for necklaces, ear-drops, inlaid work, and other similar objects. Its lustre is extremely agreeable from the play of light it exhibits; and would no doubt be highly prized were it more rare and harder, it being easily scratched.

ALABASTRITE is that pure, and almost translucid substance, usually known as Alabaster, and whose whiteness has become a term of comparison. It is easily sculptured, may be turned upon a lathe, and is susceptible of a considerable degree of polish. Of it is manufactured those graceful vases and other tasteful objects which are brought to us from Volterra and Florence. The ancients made small vessels of it for containing perfume. We are also informed that the Temple of Fortuna Seia was constructed of this substance; and that although it was without windows, the walls admitted into the sanctuary a dim religious light. Sentimental imaginations have ever luxuriated in the peculiar charms of a mys-

terious and subdued light; the landscape illumined by the pale rays of the moon inspires calm, and invites meditation; and the light from an alabaster lamp is not only grateful to the sight, but favourable to reverie.

You cannot fail to have observed, my dear Florence, that I have mentioned two kinds of Alabaster, the one a carbonate of lime, and the other a sulphate. The former is the harder and the more esteemed: it derived its name, according to some, from Alabastron, a village of Egypt, where it was anciently worked; but, according to others, the name signifies *difficult to hold;* the vessels formed of it being highly polished, and without handles; and in this case the name of the village may have been derived from the existing manufactory. Be this as it may, the substance of which I now speak, and which has been called Oriental or Calcareous Alabaster, in contradistinction to Gypsous Alabaster, is rarely seen white; but, on the contrary, is veined and clouded with different colours, usually of a dirty yellow or brown, but sometimes red, blue, or black. The colours themselves, and their arrangement, are due to the mode in which this Alabaster is formed.

As water percolates through the roofs of the caverns in lime-stone rocks, it carries with it a portion of the stony matter. The drops falling upon the floor of the cavern, leave upon the roof a small ring of stony sediment, while the water which falls, evaporating from the bottom, leaves a sediment there also. The continual addition to the rings at the top forms hollow tubes, which are the foundations of the stalactites, of which I have spoken to you, while the

sediment at the bottom, increasing upwards, forms the stalagmites. In time, these increasing both ways unite, and extending also laterally, large masses of Alabaster are formed. But as the water carries with it particles of the limestone, it also carries infinitely small particles of the other substances through which it has passed from the upper surface of the earth; and these it is which colour the Alabaster; and as the mass of Alabaster is formed of successive layers, so the colouring matter is deposited in bands variously contorted. You have heard of the celebrated grotto of Antiparos, so minutely described by the Duke de Choiseul Gouffier; it is perhaps the finest example of a stalactitic formation, though there are many other examples, among which that of Castleton in Derbyshire is not the least remarkable. At Gibraltar a variety of dark brown and yellow-zoned Alabaster is found, and a confection of sugar, well known to school-boys under the name of *Gibraltar-rock*, is so called from its resemblance to the natural formation. This variegated Alabaster, which has also been named Onyx-alabaster, was much prized by the ancients, as also a variety of an uniform honey-yellow tint.

You have just heard that the *élégantes* of antiquity, for that character is not of modern invention, kept their perfumes and cosmetics in vessels of Alabastrite, that is, of the Gypsous Alabaster; but the Roman ladies applied the Calcareous Alabaster to a very different purpose. They had vases made of it to receive the tears they shed on the death of their husbands, whence they were called *Lachrymatory Vases;* you may see some of them in our museums,

and will agree with me that, if they had to be filled, much more watery grief was manifested then than now for the loss of a lord and master. May you, dearest coz, never have occasion to shed other tears than those which spring from a compassionate sympathy, or an excess of joy. The ancients also made urns of this Alabaster, in which they preserved the ashes of the dead; they were called *Cinerary Urns.*

Well, you will say, there certainly are many modifications of lime or calcareous earth; but, ere I close my letter, I must mention one or two more of which you are not perhaps aware, though they do not properly belong to the mineral kingdom. Nature in forming the frame-work of our bodies, and that of all animals, has again had recourse to her favourite ingredient lime. Yes, Florence, the bones of men, aye, and of women too, of all animals, great and small, of birds and fishes, the shells of eggs, and of the crustaceæ, the tests of lobsters, &c., are still lime, but to which is occasionally added phosphoric acid, and, with your leave, the beautiful teeth of my amiable cousin, so white and regular, and which are so agreeable to behold, when a smile parts her lips, are nothing but lime.

I have only to add, that *Phosphate of Lime*, under the name of Apatite, is also a mineral.

LETTER V.

Quartz in general—Rock-Crystal—Bristol Diamonds—Amethyst—Rose Quartz—Green Quartz—Yellow Quartz, or Cairngorm—Smoky Quartz—Orange-coloured Quartz—Blue Quartz, or Leuco-Sapphire.

YOU are pleased to say, my dear Florence, that my last letter has somewhat reconciled you to Mineralogy; that you found it much more to your taste than my account of that "odious magnesia," and sal-volatile, and alum. I am indeed happy to be thus encouraged to proceed with my lessons, but must, at the same time observe, that it is no fault of mine if every subject to which I may call your attention be not of equal interest in your eyes. Everything in nature has some use; and although there is nothing I so much dislike as a pedantic woman, I see no reason why a lady should not be as well informed as one of the other sex. A certain acquaintance with everything she sees cannot but be agreeable, and in many cases, may be eminently useful even to a lady. With this persuasion once for all expressed, and which, I trust, will be shared by my intelligent pupil, I shall proceed in my task, taking my several subjects in order, not omitting any merely because they may have less interest than others.

QUARTZ.—I shall now speak to you of Quartz, a mineral most extensively distributed, and, like lime, assuming many different aspects. It forms about one third of the mass of those immovable hills, whose summits pierce the clouds, and nearly the

whole of the mobile soil of the trackless desert, rolling with the wind like waves of the sea. Quartz disseminated in the granite of the gigantic Himalaya, enables it to resist alike the frost of the most elevated regions and the fire of heaven; or in the gneiss of the bold Scandinavian coast, to present to the battering ocean an insurmountable barrier. At the foot of Mount Atlas it forms that sea of sand, the Sahara, whose sad sterility encroaches daily on the fertile oases that stud it like islands, and which, convulsed by the terrible simoom, buries whole caravans beneath its dusty waves. In the form of thick veins, Quartz traverses rocks from summit to base, binding the strata together: disseminated in the mass of the rocks, it increases their hardness, and diminishes their tendency to decomposition; in the arenaceous form it is often a desolation. But let us leave these generalities.

Quartz, more generally known under the name of *Rock-crystal*, though the latter belongs properly to that variety only whose transparency has become proverbial, or under that of *pebble*, which is a generic name for all those rounded stones we find beneath our feet, is particularly deserving of attention on many accounts.

The characteristics of Quartz are extreme hardness, and infusibility without the addition of some other substance. This stone is almost pure siliceous earth, its fracture is conchoidal, vitreous, and wavy. All its varieties, with the exception of iron-flint, however coloured they may be, or however opaque they may seem, are translucent at their thin edges. This mineral is not particularly heavy, being little

more than twice the weight of an equal bulk of water.

Nothing, unless it be the diamond, or the white sapphire, or the white topaz, can equal the beauty and brilliancy of certain crystallized specimens of Quartz. An hexagonal prism, with a six-sided pyramid at one or both extremities, is the most usual form; and the exact symmetry, the sharpness of the edges and angles, the high polish of the surfaces of some of the crystals, are truly admirable. The crystals of this mineral are rarely isolated, most generally there are many together of different sizes, penetrating and crossing each other, so as to form very beautiful groups. These prisms are sometimes infinitely slender, and at others exceedingly large; but in the latter case they are rarely so exactly symmetrical or so perfectly pure and transparent as when smaller. It occasionally happens that the prisms are extremely short, or totally obliterated, so that the bases of the opposite terminal pyramids join, forming a twelve-sided figure with triangular facets of great regularity. Nothing can well be prettier than a piece of bright pyrites, studded over with small crystals of this kind, which sparkle like so many diamonds; sometimes it is a large quartz-crystal that is sprinkled over with minute crystals of pyrites, showing all the colours of the rainbow. Some specimens of rock-crystal contain foreign substances in their interior, without diminishing their transparency. But of these accidents I shall speak hereafter, calling your attention first to the various colours assumed by Quartz.

I informed you in my last, that the different varieties of fluor-spar present, as far as mere colour

goes, the appearance of some of the gems. Quartz resembles them still more closely both in colour and hardness. Thus, Rock-crystal of a violet colour of various shades is called Amethyst, of a red colour, it is the Bohemian or Silesian Ruby; green, it is the Chrysolite of certain authors; yellow, it is the Occidental or false, or Bohemian, or Scotch Topaz, called also Cairngorm; brown, it is the Smoky Topaz; blue, the false or Leuco-sapphire, or Siderite: it is also met with black.

And first, of that which is colourless and perfectly transparent, that, in a word, to which the name of Rock-crystal is most properly given, a name derived from two Greek words signifying 'cold and congelation;' the ancients considering this substance to be water crystallized like ice, or, more probably, from its resemblance to ice.

The finest specimen of this substance comes to us from Madagascar, although it is also found in the four quarters of the globe, but principally in the Brazils, in Siberia, in Mount Caucasus, and the Alps. From the latter of these mountains was brought that immense crystal which figured among the objects taken in Italy by the French, and borne in triumph to Paris in 1797. It is three feet in diameter, and weighs, it is said, eight hundredweight; but Fresange, in his *Travels in Madagascar*, speaks of a crystal twenty feet in circumference!

Rock-crystal is found in druzy cavities and veins in different kinds of rocks, principally those of granite formation; it is also found in the beds of rivers as pebbles, which are very pure and limpid, and susceptible of a fine polish. These have been dignified

by the names of Bohemian Diamonds, Bristol Diamonds, Diamonds of Fleurus, of Alençon, of Marmaroch, of Paphos, &c.

It would appear that the ancients obtained their Rock-crystal from Switzerland, for Pliny says, "The Crystal grows in the rocks of the Alps." Vases of this substance are much esteemed. Nero had two cups of it which he broke in his rage when he heard of the revolt that caused his downfall: one of them was estimated at upwards of £600. The Empress Livia is reported to have presented to the Capitol a piece of pure Rock-crystal weighing fifty pounds. The *élégantes* of Rome were in the habit of using balls of Rock-crystal in the summer to cool their hands.

In the *Cérémonies Religieuses de tous les peuples*, it is said that the Great Altar of the temple of the Virginians, called *Utamussak*, was a solid Crystal, three or four inches square. This Crystal was so transparent that the grain of the skin of the hand could be distinctly seen through it. Nevertheless its weight was so prodigious that, unable to carry it away any further, they (the Virginians?) were obliged to bury it in the vicinity, to prevent its falling into the hands of the English.

In our own times Rock-crystal is still prized, and we continue to work it into cups, vases, seals, and other ornaments, and into pendants for lustres, though, for this last purpose, the artificial production is now almost universally substituted.

In 1652 a block of Crystal was found in Switzerland, which, three years afterwards, was fashioned into a vase at Prague holding six *setiers*, Prague measure; and which was presented to the Emperor

Ferdinand III. by Sebastien Peregrin de Zeveyr d'Evebach, an officer of high rank in the service of His Majesty. An engraving of this vase, executed at the same time, may be seen in the cabinet of engravings of the Royal Library at Paris, and also in the ninth volume of the *Tableau de la Suisse.*

The most beautiful work executed in Rock-crystal is, in the opinion of Mr. Sage, an urn nine inches and a half in diameter, and nine inches high, and of which the pedestal was taken from the same block. This vase is enriched with carvings and masks, and the history of the intoxication of Noah, all most admirably sculptured. This splendid piece of workmanship, which belonged to the King of France, cost upwards of £4000.

Mr. Krayer, a Genevan lapidary, cut two chains, of three loose links each, out of a piece of Rock-crystal. But one of the most remarkable uses to which the substance we are considering has been applied, may be seen in the cathedral of Milan. Here, in a subterranean chapel, adorned with the greatest magnificence, the corpse of the virtuous St. Charles Borromeo, richly clothed in pontifical habits, covered with precious stones, reposes in a shrine wholly formed of plates of Rock-crystal of six or eight inches square each, set in a frame-work of silver. This shrine was given by Philip IV. of Spain, who employed eight years collecting the necessary quantity of Rock-crystal.

The Chinese, as well as Europeans, display much skill in working this stone; they cut it into buttons, seals, the figures of animals, &c., and also fashion it into burning-glasses. Our own opticians employ it

for spectacles, under the name of *Pebbles*, and also for telescopes.

The usual price of Rock-crystal is from four to twenty shillings a pound, according to its quality.

Amethyst.—The second variety of Rock-crystal, and that which is the most esteemed, is the purple-coloured, or Amethyst. This pretty stone, whose tint reminds us of the modest violet, owes its name to a Greek word, signifying *that which is not drunk*, or, as we may say, wine tempered with water, which is indeed the sense given to the name by Pliny. The Amethyst appears to differ from ordinary crystal in no other respect than as regards its colour, due to the oxide of Manganese, which is also the cause of certain plate-glass having an amethystine tint, as you may have observed in many houses at the West end of London.

Amethyst is usually found crystallized, but the crystals are in general small. It is rare to find a large specimen in which the colour is equally intense throughout; the tint is generally richest at the end of the crystals; but it is at all times extremly fugacious, and is entirely destroyed by heat. Amethyst is almost exclusively found in the veins of metalliferous rocks; it has very rarely been seen in pure granite. The finest pieces come from Ceylon, the Brazils, Silesia, and the kingdom of Murcia in Spain. Some years since a block of Amethyst was sent from the Brazils to Calcutta, four feet in circumference, and weighing 98 pounds; it was probably a group of crystals. Agate balls are sometimes lined with crystals of Amethyst: this is generally the case with those that are found in volcanic countries, as in Auvergne, in

the Tyrol, the Palatinate, &c. In the Brazils specimens are met with of two colours, generally violet and yellow, or violet and green. The Count de Bournon possessed a cut and polished specimen, half violet and half yellow, which had a very agreeable effect.

The ancients believed that the Amethyst had the virtue of preventing intoxication, and that one might drink with impunity out of a vessel of Amethyst. They also thought that by wearing this stone, they could foresee future events in dreams, that it drove away evil thoughts, assured presence of mind, and secured the favour of princes; and when adorned with figures of the sun or moon, it was worn as a charm against poisons. With all these notions to recommend it, we cannot be surprised that it was the favourite stone of the Roman ladies. The head of Bacchus was frequently sculptured on it, and many other subjects. In the Royal Library at Paris there is an Achilles, as also a bust of Trajan, of Amethyst: this latter came from Prussia.

The Amethyst was the eighth of the twelve stones that adorned the pectoral of Aaron, the High Priest of the Jews: on these stones were engraved the names of the Twelve Tribes: on the Amethyst I believe was that of Issachar. In our own days, the Roman Catholic Bishops wear a ring of Amethyst, whence it has received abroad the name of *Bishop's Stone.*

The following curious circumstance, *apropos* of the Amethyst, is mentioned by Mr. D'Israeli in his *Curiosities of Literature.* "There was found on an Amethyst a number of marks or indentations which

had long perplexed antiquaries, more particularly as similar marks or indents were frequently found on ancient monuments. It was agreed on (and as no one could understand them, all would be satisfied) that they were secret hieroglyphics. It however occurred to the French antiquary Pieresc that these marks were nothing more than holes for small nails, which had formerly fastened little laminæ that represented so many Greek letters. This hint of his own, suggested to him to draw lines from one hole to another, and he beheld the Amethyst reveal the name of the sculptor, and the frieze of the temple, the name of the god. This curious discovery has been since frequently applied."

Amethysts are still much in fashion, and a complete set of female ornaments, when the stones are large and of a fine and uniform colour, is much prized. The late Queen Caroline possessed a necklace of Amethyst of the greatest beauty. It is recommended to set this stone in gold, but some have lately been mounted in frosted silver with excellent effect. Surrounded with brilliants, or even with pearls, this stone looks very pretty. Nevertheless, rich as is the colour of the Amethyst as seen by daylight, it loses all its beauty by the artificial light of our tapers, when it appears of an undecided brown.

In order that you may have some idea of the value of this stone, you must know that a fine Amethyst of the weight of 30 grains is worth from sixteen to twenty shillings.

Amethystine masses, under the name of *Prime d'Amethyst*, are occasionally met with cut into plates or formed into cups, snuff-boxes, and similar objects;

it would seem to be composed of a close mass of intersecting crystals. There is in the Dresden Gallery a painting executed upon this substance.

Rose, or Milk-Quartz, as it is also called, is often of a very pure and agreeable tint, sometimes of a most delicate pink or flesh-colour, and at others of a crimson red; it also occurs of a pearly grey, or with a milky or gelatinous lustre and faint yellowish or blueish tint. Like Amethyst, this stone loses its colour, which it owes to manganese, by exposure and heat.

This pretty variety of Quartz, which has not, as far as I know, been found crystallized, is met with in considerable masses at Rabenstein, in Bavaria, in a vein of manganese traversing a coarse-grained granite. It also exists at Abo in Finland, near Cork in Ireland, at Chateau Neuf in Auvergne, and in the Isle of Coll, off the West Coast of Scotland, as likewise in Connecticut and Maine in the United States, and in South Greenland. Very fine specimens are obtained from Kolyvan in Siberia.

The larger masses are worked into vases and similar objects. M. de Dree possessed a very beautiful one, nine inches high and two feet in diameter. The bright red variety, known as the Bohemian Ruby, when cut and polished is a handsome stone, which jewellers sometimes endeavour to pass off for the Spinel Ruby; but it may be easily distinguished, as it has neither the hardness, nor the transparency, nor the fire of the gem.

Green Quartz, sometimes called the Green Amethyst of the Brazils, is also a very pretty variety of Rock-Crystal: its colour seems due to iron; by

some writers it has been confounded with Prase and with Chrysoprase. Indeed there is great confusion with regard to these green stones. I think, however, we may make the following distinctions.—Green Quartz has all the characters of Rock-crystal, but it is of a dark olive or leek-green colour, uniformly distributed throughout the mass, and sometimes with a greasy aspect. It must not be confounded with the Quartz that is mixed with Chlorite, which has the appearance of a cloud suspended as it were in the interior of the mass, or forming merely an exterior crust.

The *Prase* of Haüy is an Agate, and is the same with the Chrysoprase or Green Calcedony; the colour of which is light and soft, and whose fracture, unlike that of Quartz, is even, waxy, and sometimes scaly. In the leek-green variety of Calcedony the fracture is smooth: its colour is due to Nickel. The *Silex Prasien* of M. Brongniart differs from Green Quartz, or Quartz Prase, by a dirtier colour, and by its fracture, which is conchoidal and not waxy. This stone seems to be an inferior variety of the *Plasma* of Italian authors.

Another mineral, *Prehnite*, has also been confounded with the preceding stones, sometimes under the name of Chrysoprase, sometimes under that of *Crystallized Prase*, or of Chrysolite, which latter is a variety of Peridot.

It would appear that the ancients were acquainted with many of these stones; they engraved them, and probably often confounded them one with another under the name of *Smaragdus*, or Emerald. The more or less equal distribution of colour, as well

as the tint itself, when the stone is cut and polished, can alone enable you to decide to which species it really belongs, and the same characters, together with the fracture, will enable you to distinguish among the rough specimens.

The name Prase is derived from the Greek, and signifies leek-green. The finest specimens of Green Quartz come to us from the Brazils, but it is also found at Mummelgrund, in Bohemia, near the Lake Onega, in Northern Russia, and elsewhere. At Munich they make pretty snuff-boxes of a variety of Green Quartz with imbedded garnets; it is improperly called granite.

YELLOW QUARTZ is a very pretty stone, which in colour resembles the Topaz, whose name it has usurped, and for which it is often sold, though it has neither the hardness, nor the weight, nor the brilliancy of the latter. This variety of Rock-crystal is found in many places, but more especially in the Brazils, in Siberia, at Cairngorm, in Scotland, and at Olivet, near Orleans, where it occurs, together with Rose-Quartz, and sometimes, though rarely, with Blue and with Green Quartz.

A curate of Olivet is said to have had a crown made of these pebbles for the *sun* of his church; (under this name is known the receptacle in which the consecrated wafer is exhibited in the Roman Catholic Church;) and, it is said, the stones were so artistically arranged as to produce a very brilliant effect.

Yellow Quartz is very much employed in jewellery, for necklaces, brooches, ear-drops, &c., and more particularly for seal-stones, which purpose it answers admirably.

Smoky Quartz is more or less brown, but when it is of a good and uniform colour, it is by some preferred to the last-named variety. It is asserted that it may be deprived of its colour by boiling in tallow, or that it may be changed to a fine bright yellow by heating it gently, and for a long time. Smoky Quartz is generally of the very first quality of Rock-crystal; it sometimes passes into black. Its localities are the same as those of the yellow variety.

Orange-coloured Quartz, or false Hyacinth, is of a rich yellow, or reddish brown, similar to the *Zircon*, or to the rich yellow Brazilian Topaz. This variety comes from the Brazils, and is one of the most precious, by reason of its rarity and tint. M. Haüy says it has also been met with in Spain.

Blue, or Sapphirine Quartz (which must not be confounded with *Sapphirine*, the latter being a very different mineral) is of a pale blue, and was known to the ancients by the name of *Leuco-Sapphire*, which, in its turn, you must not confound with the Lux-Sapphire, which is not a Quartz, but a real colourless Sapphire. It is sometimes greyish, and is crystallized in dodecahedrons, or twelve-sided figures. This kind is found in Spain; the other varieties are from Bleystadt, in Bohemia, and from the Bodenmais, in Bavaria. They also occur at Grenada, in Spain, &c. The Bavarian variety has received the name of Peliom. Those specimens of Blue Quartz which are cut *en cabochon* come from Macedonia. But the more esteemed variety, if, indeed, it be the same stone, goes under the name of *Dichroite*, or *Cordierite;* the latter of these names from Mr. Cordier, the former

from the Greek, signifying 'two colours.' It is also known by the name of *Iolite*, from the Greek, meaning 'violet-coloured stone.' It is remarkable as possessing not two, but three different colours, according to the aspect under which it is considered. Thus, it is violet by reflexion; of an indigo-blue, when looked at in the direction of the axis of the crystal; and of a brownish yellow, as seen perpendicularly to that axis. According to Mr. Cordier, however, the Dichroite should not be confounded with Blue Quartz. Be this as it may, the stone we are speaking of is very light coloured, and not much valued; most generally it is cut like an emerald. As to its value, a stone of ten lines by eight was sold for six guineas and a half.

The Dichroite has supplied Dr. Brewster with the means of making a great variety of very interesting experiments on the properties of light, but they are foreign to our purpose; and, indeed, my letter is very long, for which I ask pardon of my amiable pupil, and, profiting by a kind of natural division of my subject, I shall conclude our lesson for to-day, leaving till my next the consideration of other varieties of Quartz, not less interesting from their brilliancy, and which add to their beauty the advantage of not deceiving us by false appearances.

LETTER VI.

Chatoyant Quartz, or Cat's-Eye—Girasol—Avanturine Quartz —Iris—Ferruginous Quartz, or Hyacinth of Compostella.

AFTER you had concluded the reading of my last letter, I make no doubt but you exclaimed, "What, then, are we for ever to be imposed upon? I knew very well that art had so far succeeded as to make tolerable imitations of the precious stones, yet no one would have the impudence to pass off paste as diamonds, and coloured glass for gems; but now it appears that we are not unfrequently cheated even with real stones, and, that unless one be a mineralogist, it is hard to discover the fraud. Who knows but my beautiful suite of Topazes, so much admired at the last assembly, may not, after all, be only common Scotch pebbles? To say nothing of my purse, so unceremoniously lightened; but that odious old Dowager, so learned, and so ill-natured, who takes so much pleasure in depreciating whatever belongs to the young; I think I see her shrugging up her shoulders, and hear her exclaim, with that malicious air so habitual to her, 'Topazes, indeed! you are very good! I have seen that *parure*, my dear Sir, you so much admire, and I can assure you it is composed of nothing more than those common little pebbles which the children amuse themselves with picking up out of the beds of the rivulets near Orleans. Yes, Sir, I know them well; my very dear friend, the Duchess of K—, has had a collar studded with them for her little spaniel. But so

it is, young people are so fond of show; and besides, it is a deception which not every one can discover—though when discovered, it is most frequently found that the outside and the in are in perfect harmony, and that deception in dress accompanies duplicity of character.' Yes, old made-up, thus it is that an imposition practised upon me has afforded you a fine opportunity for the exercise of your envy. But never mind, my friend Mr. B— will tell me the truth. I will take my *écran* to him immediately. Ah! M. Jourdain was right. Science is, indeed, a fine thing, if it only teaches one to distinguish Topazes from Rock-crystal."

But no, you need be under no apprehension, my pretty Cousin, the jeweller with whom you deal has a well-merited reputation, and would not risk the loss of it by so dishonourable a proceeding as selling you rock-crystal for real topazes. I have seen your jewels, and I know them all to be real; and were I addressing you in the style of certain writers of letters, I would say, your topazes are brilliant as your imagination, your rubies sparkling like your wit, your emeralds tender like your heart, your amethysts harmonizing with your well-balanced character, and your sapphires celestial like your thoughts. Or, were I a lover, I would swear the jewels of your *casette* are the emblems of your eyes, your lips, your complexion; but fear not, you have too much good sense to be thus trifled with. I shall, therefore, return at once to our subject, from which the pebbles of Olivet have for a moment diverted our attention.

I have shewn you Rock-crystal of different colours, more or less durable, and more or less equably dis-

tributed throughout the mass. I shall now speak of those varieties of Quartz which, instead of fixed colours, present only plays of coloured light; and first of—

CHATOYANT QUARTZ.—This variety is what you know by the name of *Cat's-eye*, a specimen of which your friend B— brought you from Ceylon, and that you very judiciously had set in a ring. Yours, if I remember right, is of a brown colour; some are olive-green, and some white. The green and the brown varieties are the most esteemed.

The Cat's-eye is brought from Ceylon, from the Malabar coast, and the Cape of Good Hope; other localities are also mentioned, as the Island of Sumatra, Persia, Arabia, and Egypt, North Greenland, the Hartz, Hoffen Bareuth, the Pyrenees, &c. But as there are different stones which much resemble the real Chatoyant Quartz, it is likely enough that some of them may have been mistaken for it. Mineralogists themselves are not quite agreed as to the place in the system which this stone should occupy; but as it contains 95 parts in the 100 of silica, it seems very properly placed by the generality of mineralogists along with Quartz. It owes its name of *Cat's-eye* to the pearly light it exhibits, and which is not unlike that observed to emanate, as it were, from the interior of the eye of a cat. This singular effect results from the minute fibres of which the stone is composed and their parallel arrangement; or, from an intimate admixture of some foreign fibrous body, such as amianthus. Count de Bournon considered the *Cat's-eye* as an agatized wood, and it appears that several of the specimens which are seen in collections confirm the opinion.

Cat's-eye was for a long time confounded with Felspar, from which, however, it is now very properly separated, as it differs entirely from the latter in the more essential characteristics. Thus the fusibility of Felspar is very great, while Chatoyant Quartz is absolutely infusible; and while the fracture of Felspar is lamellar, that of Quartz is according to the direction hackly or slightly conchoidal.

The Cingalese sell the Cat's-eye already cut *en cabochon*, so that its exact site was long, and, perhaps, is still unknown; but as we now possess the whole of Ceylon, it is not unlikely that the precise locality which supplies it may have been ascertained, though possibly it may hitherto have been found only as pebbles in the mountain-streams of the island. The specimens rarely exceed the size of a nut. I have read, but I believe the statement to be exaggerated, that a Cat's-eye of the size of a hazel-nut is worth £150. The larger pieces are sometimes cut into the form of a monkey's face, which has a very good effect. One of these heads of four or five lines in diameter, was sold for three guineas; a most insignificant sum as compared to the enormous price set upon a real Monkey's-tooth in Ceylon. I must tell you the story.

You know that nothing can exceed the strangeness and incomprehensibility of Indian Mythology, but you, perhaps, are not aware to what extent the monkey was, and still is, venerated on the coast of Malabar and at Ceylon. At the latter place, then, there formerly existed a temple consecrated to the worship of Siri Hanuwan, or Anemonta, a monkey-god. The temple, besides its great magnificence,

owed its chief reputation to the tooth of a monkey, which the people in their credulity worshipped, and which they preserved in a rich shrine, adorned with the most valuable jewels. The Portuguese, in a descent which they made upon the island in 1554, plundered the temple and carried off the precious relique. Well, would you believe it? there was found an Indian Prince, who, indifferent about the rich shrine, offered the Viceroy of Goa, for the tooth alone, *seven hundred thousand ducats of gold;* but, what is more surprising still, the offer was refused! This extraordinary veneration for the monkey, in the island of Ceylon, may have induced the natives to cut the head of that animal on stones, as the Egyptians sculptured the beetle; and hence it is probable that the *Cat's-eyes* so sculptured, came to us originally from the island itself; for otherwise, it is not easy to divine why Europeans should imitate the head of the monkey in preference to that of any other animal: both the monkey and the stone coming from the ancient Serendib.

Girasol Quartz.—There is another stone respecting which mineralogists differ in opinion. Brisson and Patrin pretend that the *Asteria Sapphire* alone should bear the name of *Girasol.* Haüy says it is a *Quartz Resinite.* Brard also places it with the Quartz. Brongniart calls it a *Silex.* Jameson, Phillips, and Chapman, call it an *Opal,* in which they seem to agree with Werner. Count de Bournon thinks this mineral should have a place to itself. Others have confounded it with the *Sun-stone,* which is an *Avanturine Felspar.* Much of this diversity is only apparent, for in truth, as the celebrated Haüy has

proved, Silex is only a modification of Quartz; or rather this latter is a modification of Silex, and all the agates, the calcedonies, the opals, &c., are but so many varieties of Quartz. We may, therefore, consider the Girasol as a *Quartz Resinite*, since its resinous fracture is one of its principal characteristics. This stone presents various colours, for the most part undecided, though it is sometimes found of a fine yellow and of an emerald green. The most general tint, however, is a bluish white, with a more or less brilliant red or yellow reflexion when held to a strong light. This reflexion seems to come from the interior of the stone, and to follow the light presented to it; whence the name of *Solgirans*, in Latin, or turning to the sun.

Brard mentions a piece of Quartz Girasol, of about fifteen lines in diameter, whose brilliant opalescence presented at the same time a bright image of the rising sun and the soft light of the moon, and for which the owner had refused £1000. The same author says, this pretty variety of Quartz comes from Siberia, but that the brightest are brought from the Brazils.

The ancients held this stone in high estimation; they called it also by the name of *Asteria;* and they preferred that which came from Caramania to that from the Indies.

The manufacturers of Strass-paste imitate the Girasol perfectly with a kind of glass, into the composition of which they put a small dose of the oxide of tin.

Avanturine Quartz.—As the circumstance to which real Avanturine owes its appearance may be

common to many stones, it is essential to add to the name Avanturine, which merely denotes such circumstance, the proper name of the stone thus distinguished. The two minerals, however, which are the most frequently *avanturined*, if I may so say, are Quartz and Felspar. I shall for the present mention the former only, though it is much less prized than the latter.

Avanturine Quartz owes its aspect to a multitude of infinitely small cracks, running in nearly the same direction throughout the mass. Now as Quartz is met with of various colours, so accordingly the brilliant specks presented by the Avanturine assume the appearance of a gold or silver powder dispersed throughout the stone. Care must be taken to distinguish between true Avanturine and another species of Quartz, in which disseminated and very minute particles of mica produce a somewhat similar appearance. This latter is by far the most common. It is met with in much larger pieces, and is employed cut into tablets for snuff-boxes and similar objects, and also for vases. It is much less valued than the former variety.

The name of Avanturine Quartz is often given to large blocks of Quartz which are only avanturine in certain spots, patches, and bands, the remainder of the mass having nothing to distinguish it from common Quartz. As these masses, however, are not abundant, and are susceptible of a brilliant polish throughout, they are cut into vases. Blocks of this substance are found in Siberia; and from one of these a beautiful vase has been made, which is now in the possession of Sir R. I. Murchison, the celebrated

geologist, to whom it was given by the Emperor of Russia.

Besides Siberia, Avanturine Quartz is found at different places. At Cape de Gatte, in Spain, there is a white variety with silvery spots. Arragon furnishes several varieties, but chiefly the red. At Face Bay, in Transylvania, there is a kind which is black with gold-coloured specks. Avanturines are also found in Lower Brittany, and in the mountains of Scotland, and its islands. It is most probable that in this enumeration are included the two kinds of which I have spoken.

The name Avanturine is derived from the following circumstance: A French workman having by accident, or *par adventure*, dropt some copper-filings into a vitreous mixture in fusion, gave the name of *Avanturine* to the sparkling mass which was thus produced; and it is still by a similar process, though greatly improved, that the artificial production is now manufactured, to be employed for various ornamental purposes. The artificial far exceeds in brilliancy the natural Avanturine. A species of Avanturine is also produced by heating pieces of Quartz to a certain degree and suddenly cooling them; this occasions a number of minute fissures in the mass, which by the unequal refraction of the light gives the stone the desired appearance.

Quartz Iris.—This variety, like the preceding, owes to accident the rainbow-colours which it reflects, and to which it owes its name. These colours are sometimes in patches, and sometimes in streaks or bands. They are the result of internal fracture. They are thus found naturally, but may be artificially

produced with a little address, by striking a piece of Rock-crystal sharp blows with a light hammer, or by heating and suddenly cooling, as directed for giving the appearance of Avanturine. This stone has been called by the French *des Reflets à tout ou rien;* for as they have generally but one, or very few large fissures, in which they differ essentially from Avanturine, their colours are perceived only when the stone is held in a particular direction as regards the light.

Quartz Iris is only employed for small objects, as ring-stones, brooches, &c.; nevertheless they produce a pleasing effect when the stone is cut and polished with taste. In the private collection of the King of France there is a very complete and well-selected set of these stones. The finest are said to come from the Brazils and Mexico.

All the varieties of Quartz of which I have hitherto spoken are transparent, or nearly so. There are, however, some in which the quantity of colouring matter is so great as to render the stone opaque.

Hematitic, or Ferruginous Quartz, or *Iron Flint*, or *Sinople*, or *Hyacinth of Compostella*—for it has all these, and yet other names—occurs in small crystals and massive; it is opaque. When crystallized the form is a regular hexagonal prism, surmounted with hexagonal pyramids, generally very perfect. The most ordinary colours are reddish brown or blood-red. The last of the above names was given to this variety from the place where it was discovered; *viz.*, near Compostella, in Spain, where it occurs in abundance in Sulphate of Lime (Gypsum). It is also found in England with Sulphate of Barytes;

and very fine specimens are found in the mines of Freyberg, in Saxony, as also in Bohemia and in Hungary. This stone owes its colour and its opacity to a large quantity of the oxide of iron, with which it is penetrated. Sinople may, at first, be easily confounded with *Jasper;* but it differs essentially from it in the fracture, which, in the former is shining, whereas it is dull in the latter. Jasper, moreover, is never crystallized. In some species of Sinople magnetic properties are induced by heat. It is the crystallized variety alone which bears the name of Hyacinth of Compostella. The massive variety forms an excellent seal-stone in place of Cornelian. As the Hyacinth of Compostella has generally the two terminal pyramids, and is most perfect in form and surface, and of an agreeable colour, it has sometimes been mounted in its natural state as a pin.

LETTER VII.

Rock-Crystal, with Hornblende, or Thetis' Hair-stone—R. Crystal with Green Tourmaline—R. Crystal with Chlorite —R. Crystal with Asbestus—Argentiferous R. Crystal—R. Crystal with micaceous Iron-glance, or Rubasse—R. Crystal with Hydrous Oxide of Iron, or Cupid's Pencils—R. Crystal with Brilliant Iron—R. Crystal with Rutile, the true Venus' Hair-stone—Cupid's Net, or Love's Meshes—R. Crystal, with Oxide of Manganese, or Cupid's Arrows—R. Crystal with Pyrites—Opaque Milk-white Quartz—Quartz with Calcedony—R. Crystal with Gold—Artificial Rubasse, how made—Arenaceous Quartz, or Sandstone—Crystallized Sandstone—Sculpture at St. Mihiel—Weeping Statues—Flexible Sandstone.

IN my last two letters, my dear Florence, I spoke to you of several varieties of Quartz, differing from each other either in colour or in opalescence. It now remains for me to direct your attention to another variety of this mineral, whose aspect is very agreeably diversified by other substances foreign to its nature, which are found embedded within it. After which I shall say a word or two on Sandstone, which will conclude the subject of Quartz.

There are from twenty to thirty of these, so to call them, freaks of nature; but I purpose mentioning those only which present the most pleasing effect.

ROCK-CRYSTAL, with enclosed HORNBLENDE.—In this pretty variety, the perfectly transparent and colourless Quartz encloses very slender prisms of Hornblende of an opaque green colour, crossing each other in various directions. It is found at St. Gothard, in Dauphiny, as also at Madagascar, and

is called *Thetis's Hair-stone.* Thetis, you know, was the most lovely of the Nereides, and courted by Jupiter, by Neptune, and by Apollo, notwithstanding which, and much to her mortification, after counting three gods among her admirers, she was constrained to wed the simple mortal Peleus. Beautiful, however, as we may imagine the nymphs of the sea to have been, it must be confessed that green hair adorned with branches of red coral, must have produced a somewhat singular effect. The poets, methinks, would have done better had they given the mother of the valiant Achilles, rich auburn locks, like those of my pretty Cousin, or glossy black ringlets, like those of her sister, or light, like those of of the beautiful Caroline M—. But back to our subject.

R. Crystal, with green Tourmaline.—This variety, like the preceding, is transparent and colourless, and traversed in all directions by very fine prisms of Tourmaline, of a beautiful transparent green. This exceedingly pretty variety comes to us from Ekaterinebourg, in Russia, and is worked by the jewellers into different ornaments.

R. Crystal, with Chlorite, includes several subvarieties. Sometimes the Chlorite is white, pearly, and distributed in clouds or wool-like flocks; this kind comes from the Brazils. Sometimes, though arranged in a similar manner to the last-mentioned, it is green; this is from Mount St. Gothard. Occasionally the Chlorite is in the form of a green or yellowish powder; this occurs in the same localities as the two last, and also in Dauphiny. There are also other sub-varieties, but the prettiest of them

all is that in which the crystal, being perfectly transparent, the enclosed Chlorite assumes the form of shrubs, of heath, and of moss. You are not, however, to confound this with *Moss-agate,* which is a calcedony.

R. Crystal, with Amianthus or Asbestus.—This variety is more common, but is none the less pretty on that account. It presents silky tufts of Amianthus of exceeding fineness, and of a pearly lustre. It is employed in jewellery, under the name of *Venus's Hair-stone.*

Argentiferous R. Crystal.—Fine specimens of this stone are very rare; it exhibits in the interior of the limpid mass, native silver crystallized in the form of fern-leaves. This charming production of nature comes from Guanaxuato, in Mexico.

R. Crystal, with Micaceous Iron Glance.—In this variety, the Quartz, though limpid, is sometimes slightly tinged with violet, and is besprinkled internally with minute brown spangles of specular iron, which reflect a bright red light equal to that of the most brilliant ruby. The natural *Rubasse,* or *Rubasse par excellence* of the lapidaries, is a cut and polished stone of this kind, but it is very rarely met with; its locality is the Brazils. An analogous, but much inferior variety, is found in the iron-mines of Nassau Ussing.

R. Crystal, with Hydrous Oxide of Iron.—This variety may be divided into three sub-varieties, of which the most remarkable in a mineralogical point of view, is that in which the transparent crystal, sometimes colourless, and sometimes amethystine, shews within it long, square, grooved prisms of brown

iron ore, terminated by triangular or square pyramids. The prettiest variety, however, is that to which the name of *Cupid's* or *Venus's Pencils* has been given: here the quartz is violet, and envelopes separate little delicate tufts of capillary hydrous oxide of iron, of a golden brown colour. Both these productions are met with at Bristol; and at Petrozavodsk, in Russia, as also at Oberstein; at Framont, in the Vosges; in Hungary; in Bohemia and elsewhere. In the third sub-variety the oxide is in a pulverulent state, and of a light brown.

R. Crystal, with Brilliant Iron.—In the environs of Grenoble, in the department of Isere, in France, there is found a very limpid Quartz, containing scales of iron of great brilliancy. It is worked with much success at La Grave, in the department of the Higher Alps.

R. Crystal, with Prismatic Rutile, or *Oxide of Titanium.*—Of this kind there are reckoned five sub-varieties. In that which is found at Chamouny, the delicate prisms of Rutile are half yellow and half brown; it is known under the name of *Marmots' Hair-stone.* In that from Madagascar and Brazil the embedded Titanium is in long hair-like filaments, of a light colour. This is, indeed, the true *Venus's Hair-stone*, though, as we have seen, the name is also given to the crystals which contain filaments of Asbestus. At Mt. St. Gothard a variety is found, in which the red oxide of Titanium is in needles crossing each other in all directions, and from this reticulated appearance this sub-variety has received the name of *Cupid's Net*, or *Love's Meshes.* What a fortunate thing it would be if the little god never manufactured

any other! Nevertheless, in imitation of oriental custom, a heart of this stone might be sent to a too cruel fair one, as a reproach on the hardness of that heart for which liberty had been sacrificed, but which is now seen through. And why may not many things be said by means of gems as well as by flowers? There now is a hint for you to compose a language of gems, I will not say a language of minerals; for gold is among them, and its eloquence is already proverbial.

There are also found some splendid varieties of the stone I am now speaking of, in which the transparent quartz encloses crystals of the oxide of Titanium of a light steel-grey, similar to the sulphuret of antimony. These crystals have often their points coloured red, and are remarkable for their regularity.

R. Crystal, with Oxide of Manganese.—In Dauphiny a quartz is found in which is embedded brilliant needles of the oxide of Manganese. This kind is called *Cupid's Arrows.* This oxide also assumes the dendritic form, either brown or silvery. They bring from the Brazils specimens of a colourless and also a yellow rock-crystal with these shrub-like dendrites, which, when well defined, have a very pretty effect and are worked up into various ornaments.

R. Crystal, with Pyrites.—The crystals from Dauphiny sometimes contain embedded grains of the sulphuret of iron of a golden yellow. When this variety, says M. Brard, is cut into a number of facets they multiply the brilliant specks, and produce a very agreeable appearance.

Milk-white Massive Opaque Quartz.—This kind often contains in its interior large and beautiful dendrites of a black compound of oxide of iron and manganese. It is found near Nertshinsk, in Siberia. In the collections of the curious may be seen beautiful slabs of this stone several inches square.

Quartz, with Calcedony.—In this variety the Quartz is translucid, of a somewhat greyish white, with white dendrites of opaque Calcedony.

R. Crystal, with Gold.—This, the last variety of these stones to which I shall call your attention, is certainly the richest if not the most beautiful; it is found at La Gardette, in the department of Isere. The Rock-crystal is of a fine citron-yellow, in which are embedded spangles of gold.

The greatest number of these varieties of accidented Quartz are very pretty; they are, however, rarely employed except as slabs for snuff-boxes and similar articles, and are more or less esteemed according to their beauty. There are many more than those I have mentioned; but as they are not remarkable, you will not be sorry if I spare you a fastidious enumeration. I must, however, say a word on what is called *Rubasse*. I have already mentioned the natural Rubasse, which is very rare. The term properly applies to crystals of a red colour and fractured appearance. It is produced artificially, and also of other colours besides red, though the same name is applied to all. The mode of producing the artificial Rubasse is as follows. Very pure rock-crystal is heated red-hot, and then repeatedly plunged into a coloured solution. By this operation the stone be-

comes full of cracks, and these become filled with the colouring matter. For red, cochineal is used; for black or deep red, sandal-wood is employed; for a sapphire blue, a tincture of indigo or of litmus; for yellow, whether light or deep, saffron; for a violet-blue, the juice of the buckthorn; for emerald-green, a mixture of the tinctures of litmus and of saffron, &c. The red colour is, however, preferred. White quartz, it is said, may be coloured brown by exposure to heat and the smoke of wood.

Arenaceous Quartz.—When quartz in grains is agglutinated, it forms the stone or rock known as *Sand-stone* or *grit*, which is more or less hard according to the nature of the cement that binds the grains together. This cement is either siliceous, or calcareous, or argillaceous. The first of these is that which gives the greatest solidity to the stone, the last, the least, and the calcareous is intermediate. The sandstone of Fontainebleau, which has a calcareous cement, is employed in the paving of Paris, for which it is much esteemed. Indeed, we are told that a former king of France proposed to a Sovereign of England, to give him as much of this paving-stone as he might want, in exchange for such a quantity of our beautiful English gravel as he required for the walks and avenues of his own royal gardens.

It is at Fontainebleau that is found that curious production called *Crystallized Sand-stone*; but this is a misnomer, for it is, in fact, crystals of calcareous spar containing so great a quantity of sand as to assume the rough opaque appearance of sand-stone. There are some good specimens of this in the British Museum.

The workmen at Fontainebleau recognize in the sand-stone of that place three degrees of hardness, which they designate by the names of *Pif*, *Paf*, *Pouf*, and they may defy the finest poetical genius to find more picturesque expressions or a more perfect imitative harmony. The *Pif* is the hardest, and the *Pouf* the softest stone.

Sand-stone, of different kinds, is used as grind-stones for pointing needles, &c., and as hand-stones for sharpening cutting instruments, as by mowers for their scythes. It is likewise employed for smoothing the surface of marble and other slabs previous to polishing. Those pretty specimens of agate which are made into brooches, seals, &c., and which come to us from Oberstein, are ground upon large grit-stones brought from Keyserslautern. These stones are six feet in diameter and eighteen inches broad. When worked, they sometimes fly and kill or wound the workmen. In a word, sand-stone is generally employed whenever a hard substance is to be ground or worn down. Sand-stone is moreover used as a building stone and for copings, as also for mill-stones, and some kinds are employed by the sculptor.

I remember to have seen at St. Mihiel, in the department de la Meuse, in France, a group of thirteen figures, life-size, representing the entombment of Christ, all sculptured out of a single block of sand-stone. This remarkable work was executed in 1555, by one Lichier-Michier, according to some, or as others call him Richier Leger de Dagonville, a pupil of Michel Angelo's. Lewis XIV. and Napoleon were both desirous of having the group brought to Paris: but as the figures all hold by the base to the

rock from which they are sculptured, the attempts that have been made to detach them have shewn that they cannot be removed without much injury.

There exists a kind of light porous sand-stone which allows water to percolate through its thin portions with ease. It is therefore used as a filtering stone; but we are told that it has also been put to a very reprehensible purpose. Statues of saints have been made of it, having the head hollowed out in such a manner that the cavity being filled with water, on certain occasions when the interests of the priests required it, the water oozed out through the corners of the eyes, and gave the statues the appearance of weeping.

There is a very singular kind of flexible sandstone which comes from Villa Rica, in the province of Minas Geraës, in Brazil. If a slab of this be suspended at its two opposite extremities, it bends with its own weight so as to form a very considerable curve. This property is said to be due to the mica which is mixed with it, but I doubt this.

Lastly, Quartz in the state of sand is employed in mortars and cements, and for castings; but its most important use is in the manufacture of glass. Thus by the aid of sand, with potash and a little metallic oxide, the coquette may study the airs she means to assume, the lover of good cheer admire the ruddy juice of the grape, the astronomer bring within his ken the starry firmament, and the naturalist observe the ten thousand facets in the organ of vision of the fly!

Adieu, dearest Cousin! I trust you will remember how much of what is useful and pretty we owe to

Quartz, and that hereafter, the pebble under your foot will call up interesting associations, and awaken in you a lively sense of gratitude to that Omnipotent Being who has endowed every object with peculiar properties, and man with intelligence to turn those to purposes of utility and pleasure.

LETTER VIII.

Agates — Calcedony — Cachalong — Sapphirine Calcedony— Mocha Stones—Stigmites, or St. Stephen's Stone—Anhydrites — Cornelian — Burnt-Stones—Sarde — Sardonyx— Calcedonyx—Onyx—Cameos—Origin of Onyx.

AFTER three long letters upon Quartz, I am almost afraid, lest in telling you that the mineral I am about to bring to your notice, so nearly resembles it that several mineralogists have arranged them under the same general head, you will imagine the Quartz family to be innumerable, and that all stones are merely modifications of Quartz. But, in place of impatience at finding that a great variety of objects are merely modifications of a few simple substances, you will, upon reflection, find in this very circumstance a fresh cause for admiration. Indeed, the more closely we examine the various objects scattered over the earth, the more our interest and wonder are increased at the small number of elements employed by the Creator for the production of so much variety. Thus, the pure, colourless Rock-crystal, of which I have spoken to you, and Silex, are considered one and the same thing, though a little Alumina seems to have been discovered in specimens of Rock-crystal by some analyists, while the Agates, and other Siliceous stones, of which I am about to speak, contain a much greater quantity of Alumina than Quartz, from which they are accordingly distinguished.

By M. Leyman the Silexes, or Siliceous stones, are divided into four groups: 1st, Silex, of a fine texture, or the Agates; 2nd, Silex, of a coarser texture, as Flints, properly so called; 3rd, Silex, of a resinous appearance, or Silex-resinite, that is, the opals; and 4th, Pseudomorphic Silex. Adopting this arrangement, I shall begin with the fine-textured Siliceous minerals, or the Agates.

AGATES have a homogeneous, or uniform substance or texture, which is very fine; their fracture is generally conchoidal, but sometimes scaly. Some are agreeably translucent, others are opaque, except at their edges. They are found of all colours, and these are sometimes exceedingly vivid, sometimes equably pervading the entire mass, and at others most agreeably, and often curiously varied and distributed. Agates are very hard, giving fire with steel; and, when broken, the edges of the fragments are very sharp. Such are the general characteristics of Agates. I shall now pass on to their varieties.

CALCEDONY.—This pretty stone owes its name to Chalcedon, that once famous city of Bithynia, in Asia Minor, where Mithridates struggled against the Romans—where the defeat of Licinius left Constantine sole master of the empire—where Theodora, the wife of Justinian, had a most sumptuous palace, and where three famous Councils were held on the schism that distracted the Eastern Church. The rocks near this place, which is not far from the present Scutari, contain Calcedony in considerable quantity.

This stone varies in colour from a milk-white to a bluish and a reddish-white; it sometimes passes

into greyish white, and is occasionally pinkish. It is also found of a honey-yellow, or a very soft blue, and, though rarely, quite pink. Occasionally it is met with irised, or with rainbow-tinted reflexions, and sometimes it has a satiny lustre. It is generally translucent, though some specimens are almost transparent. When, though white, it is quite opaque, it takes the name of *Cacholong*. The finest Oriental Calcedony presents in its interior a very agreeable mottled appearance.

Calcedony is found in mamillated masses, stalactitic, and in kidney-shaped or nodular pieces: the former of these furnish the finest specimens. This stone is susceptible of a very high polish, and is very extensively used in jewellery, for brooches, necklaces, ear-drops, &c.; as also for little boxes, cups, and other similar ornamental objects, much esteemed by amateurs.

The ancients, according to Pliny, quoted by Brard, got their Calcedonies by the way of Carthage; they came, some say, from mountains in the neighbourhood of Thebes. There are some very fine engraved Calcedonies in the Royal Collection at Paris; among others, the bust of a young warrior; the bust of the goddess Roma; the Dionysiac bull; and other subjects most exquisitely cut.

Blue Calcedony, which has also been called Sapphirine-Calcedony, is very scarce, and much esteemed; it is found at Nertchinsk, in Siberia, and in Transylvania.

The ordinary situation in which Calcedony exists is in ancient lavas, whose cavities it occupies. The countries of Europe that are the richest in Calcedony,

are Iceland and the Faroe Islands; from which localities, it is said, came the fine collection brought from Denmark to France, by the President Ogier, and which included nodules of the size of the head, and stalactites of the greatest beauty. Calcedony, however, is found in a great many places, and in different kinds of rock.

Accidented Calcedony.—The appearance of Calcedony is sometimes varied very prettily by the infiltration of oxide of manganese and of iron; these substances assume dendritic forms; and the stones so accidented are called *Mocha-stones*, having been first brought from Mocha, in Arabia, which place, M. Leyman says, probably received them, with other objects of traffic, from India. This, indeed, appears so much the more likely, as in the environs of Cambay, at the bottom of the gulf of the same name, there are mines of Agate; and Niebuhr, speaking of the Cornelians of Arabia, says, "We find stones very similar to the Akjk, or Cornelian, among those of Cambay, called Mocha-stones, and of which so large a quantity is taken from Surat to China and Europe." It does not appear that the ancients were acquainted with our Mocha-stones.

Of this dendritic Calcedony there are four different varieties:—

1. Arboriform Dendrites, properly so called.—This variety exhibits black or red ramifications, extending in all directions, or in a single plane, so as to resemble a marine conferva; such, for instance, as a Ceramium; or a moss, with asperities along the branches, sometimes resembling the points of the leaves of the *Spagnum Capilaceum;* at other times,

one sees along the erect branches little globular bodies which one would be tempted to take for seeds. This latter appearance is often exhibited by the Mocha-stones, and has, perhaps, given rise to the idea that this stone contained embedded reindeer-moss, the *Lichen Rangiferinus.*

2. C. with PALMATED DENDRITES.—In this variety the dendrites are developed in the shape of lobed or puckered leaves, bearing a resemblance to some of the *Ulvæ:* these are generally drab-coloured or brown, and seldom red when held against the light.

3. C. with MOSS-SHAPED DENDRITES.—The interior of this Calcedony is filled with fine filaments, interlaced and entangled in all sorts of ways; when they are green they very much resemble a fresh-water conferva, but the colour is sometimes yellow, and even red.

4. C. SPOTTED.—This variety shews disseminated spots of brown or red, which look like drops of blood; they were formerly called *Stigmites*, or *St. Stephen's-stone*, and were once very highly prized.

You will agree with me that nothing can be more delicate than these designs executed by nature herself. Not content with giving us Mosses, Lichens, Confervæ, Byssi and Brya, she has amused herself by supplying us with such exact imitations of this kind of vegetation, that some naturalists, among whom may be reckoned Dutens, Daubenton, Blumenbach, Molé, MacCulloch, &c., have given it as their opinion, that the Dendrites observed in Calcedony are true cryptogamous plants. Dr. MacCulloch says he has seen in an agate the petrifaction of an unknown plant, resembling the bur-reed, *Spar-*

ganium Erectum. I have, in my own collection, a piece of translucent greyish-white Calcedony, containing what I have not the smallest doubt is an embedded plant; perhaps some antediluvian conferva. The stalks are tubular and articulated, and at certain distances on these there are small, flat, and very thin, perfectly round leaves, which are perfoliate; that is, the stem runs up through the middle of these little disc-like leaves: the colour of the plant is ash-grey. The principal objection, I believe, which has been urged against the existence of real plants in Calcedony is, that this stone is chiefly found in volcanic rocks, the heat of which must have destroyed every vestige of vegetation which their igneous mass approached. But the Calcedony may have been, and most probably was, formed long after the cooling of the lava, so that the stony infiltration, which, upon hardening, forms the Calcedony, may have enveloped mosses and lichens when in its fluid state. Upon the whole, then, I am persuaded that, in some cases, the Calcedony contains real plants, while in others, the Dendrites are mere resemblances of musci and confervæ, &c., due to metallic or other infiltrations, either contemporaneous with, or posterior to, the formation of the Calcedony. The red and brown Dendrites are due to iron in different states of oxydation, the black, to manganese, or, perhaps, in some cases, to bitumen, and some of the green may be owing to *Verona Earth*, a species of talc.

Dendritic Calcedony, or the Mocha-stones, are greatly esteemed when they are fine, that is to say, when they are large and the designs well characterized and developed. In the cabinet of M. de Dree, at

Paris, there was one forty-two millimetres by thirty-seven, which was sold by auction for £112, but some are stated to be worth £1000.

Calcedony is sometimes *Anhydrous*, that is to say, enclosing water in its interior. This is the case with certain little geodes of calcedony that are found in the porous lavas of extinct volcanoes. Those of the Vicentin were known in very early times, and were ranged by the ancients among precious stones. They have been celebrated in verse, and considered equal in value to the finest Arabian pearls. Pliny, who was born at Verona, thus expresses himself in speaking of these stones: "The *Enhydrites* are always perfectly round and white when polished; when turned, they exhibit an internal movement of fluctuation like that of the liquor which moves in an egg." This variety of calcedony is interesting only in as much as it contains water in its interior, but this easily escapes; an accident, however, which may be retarded or entirely prevented by keeping the stone in distilled water when not worn, it being sometimes set as a ring.

Cornelian.—The Italians, we are told, were the first who invented the Latin names *Corneolus* and *Carneolus*, subsequently changed into *Crognole* and *Cariole*, and translated into French by *Cornaline*, to designate the red agates. The name, it is said, implies that these agates resemble, by their colour, the fruit of the Cornil-tree, or the colour of flesh, or even that of horn (in French *corne*), although those varieties which are of this latter colour are called, by the French, *Cornalines blondes*.

Cornelians are essentially red of every shade, from

reddish-white to the deepest blood-red. Some have a milky aspect and some are yellow, and they are occasionally very translucid; they accompany calcedony and coloured agates wherever these are found. The Faroe islands and Scutari produce very fine ones. This stone is used in the same way as Calcedony. It should be of a very bright red, perfectly pure, and without any mixture of any other colour. It is difficult to find large masses in which the colour is equal throughout. Two little cups with their saucers of very beautiful red Cornelian, formerly in the cabinet of M. de Dree, are mentioned as something very rare. For necklaces and ear-drops this stone should not be cut with facets, but be pear or pearl-shaped; it is sometimes guillochee'd. According to Niebuhr, Cornelian is also found in the mountain of Hiram, near the city of Damar, in Arabia. The Arabs mount it and wear it in rings on their fingers, or as bracelets above the elbow, or studded in girdles, &c. They believe that it stops bleeding when applied to the part. In order to test it they wrap it up in paper, which on the application of a hot coal should not burn, if the stone be good. M. Renaud tells us that he has often seen the people of the East perform a similar operation with perfect success. They cover the Cornelian with their handkerchief, and then bring it to the flame of a taper as if they would burn it, but the handkerchief resists the most ardent flame, and even remains perfectly white.

The Orientals, in general, prefer the Cornelian to every other stone. According to them it possesses innumerable virtues. Besides, they attribute to Mohammed a saying which is alone sufficient to account

for the preference enjoyed by this stone, "He who seals with a Cornelian will always be in a state of blessedness and joy." Now, as for the experiment with the taper, I have often tried it without success; and though I have for many years used a seal of Cornelian, I have not yet found that the practice has, in any way, increased my happiness. It is very true, I am not a Mohammedan, and perhaps this singular virtue of the Cornelian is reserved for the *Islamites* alone. I strongly suspect that if ever Mohammed pronounced the above sentence, he amused himself with speaking metaphorically to his faithful Arabs; and as placing the seal to a deed terminates the operation, and as the Arabs attribute great purity to the Cornelian, we may, without any very extraordinary stretch of the imagination, translate the saying of the Prophet into common parlance thus: He who terminates an affair honestly is filled with contentment and joy.

A very great number of engraved Cornelians have come down to us. Among those of the royal collection in Paris, is the seal of Michael Angelo; Hercules shooting birds on the Lake Stymphale, in Arcadia; Hercules slaying Diomedes; a fine head of the same Hero; Jupiter, with Mars and Mercury, surrounded by the Zodiac; and lastly, the bust of Ulysses, cut on a very large Cornelian, remarkable for its colour, which approaches to that of a Sard. The seal of Michael Angelo just mentioned is a small transparent Cornelian, engraved *en creux* or in *entaille*. In the small space of six lines, little more than half an English inch, there are thirteen or fourteen human figures, without counting animals, trees and an *ex-*

ergue containing monsters, water, and a fisherman. This *chef-d'œuvre* of engraving is supposed to have been executed in the time of Alexander the Great, by the famous Pyrgoteles.

Among the antique Cornelians that are found in ruins, some appear to have been acted on by fire; these were called *burnt stones.* They have a dull appearance externally, but when held up to the light exhibit a beautiful red colour. They were much esteemed, and even now fetch a very high price, particularly if to the natural beauty of the stones be added the merit of fine workmanship. These burnt stones were afterwards imitated, and became very fashionable. It was the custom to engrave upon them the words *Simplicité*, *Constance.* These artificial onyxes were prepared by burning the upper surface of the Cornelian with a hot iron, by which it became white. There was nothing very remarkable in them; but Mademoiselle de St. Aubin, who performed with extraordinary success the part of *Cendrillon* (Cinderella), brought them into vogue, and every lady must needs have Cornelian hearts *à la Cendrillon*, *Simplicité*, *Constance.* Alas! the virtues announced by these mottoes are about as little in fashion as are now the burnt Cornelians. It must be confessed that the word *simplicity* was very inappropriately engraved on an artificial production; and a stone that turns pale on the approach of a hot iron is but a bad emblem of *Constancy.* The people of the East, much more judicious in their allegories, would have selected some object unalterable by fire, if we may judge by the fact, that an inconstant person is indicated by an

epithet meaning *what changes colour*, and which we express by Chameleon.

I must confess to you, my dear cousin, I am exceedingly fond of ingenious allegories; but false ones I detest as much as the pink ribbons and roses in the head-dress of your old Dowager. But I am wandering from my subject.

In the present day, as in former times, Cornelian is much sought after; it is worked to a great extent in Italy, and at Oberstein. This pretty production is found in Bohemia, in Saxony, in the island of Corsica, in Scotland, in Siberia, in Hungary, and in Asia Minor; sometimes in Amygdaloid trap-rocks, and sometimes in rolled pebbles. It is in this latter form that they are found at Surinam, at Java, at Ceylon, at Cambay, and at Surat in India; on the Tartarian frontier of Persia, in Arabia, on the borders of the Red Sea, in the environs of Cairo, &c.; and those so found are said to be the finest.

Cornelian must not be confounded with Red-Hornstone, nor with the Sinople or Iron-flint, of which I have before spoken.

SARDE, or SARDA.—This stone is, by many mineralogists regarded as a variety of Cornelian, from which, in fact, it differs only in its very deep red colour, which approaches to that of a dark morel cherry, or blood-red by transmitted light, but which appears of a very dark reddish brown, or almost black, by reflexion. It is found under similar circumstances with the Red Cornelian, but is rare. It is much more esteemed, and bears a much higher price than the common Cornelian. When the *Sard*

and the *Calcedony* occur together in distinct layers in the same stone, it is called a *Sardonyx*, and by some, simply *Onyx*. It would seem, however, from what is said on this subject by the ancients, that the name of *Onyx* was a more generic appellative, and that of *Sardonyx* more specific. Thus, any Agate, and even Calcareous Alabaster, in which white bands alternated with bands of another colour, were called *Onyx*, whilst the name *Sardonyx* was confined exclusively to those Agates in which white layers were succeeded by others of a blood- or flesh-red. The name *Calcedonyx* belongs particularly to those agates in which white opaque Calcedony or *Cachalong* alternates with a greyish translucent Calcedony.

We are told that the name *Sarde* is derived from the Greek 'Sarx' (flesh); but as Pliny tells us that there were Sardes not only red and reddish, but also of a light brown, and of a honey-colour, (which is not commonly that of any flesh but a mummy's,) and moreover, as his description of this stone applies to several varieties of Cornelians and Sardes, and as the Sarda, or Sarde, was first brought from Sardis, in Lydia, I am rather inclined to believe the name was derived from this locality. Of the Sardes, the darkest was the most esteemed.

The Sarde was among the twelve stones in the Pectorate of the high-priest of the Jews. It was the first stone, so we are told, which God ordered to be placed there. The Hebrews call it *Odem* (redness). There were also two in the Ephod, and, according to Ezekiel, the robe of the King of Tyre was adorned with this stone.

The name *Onyx* is from a Greek word, which signifies the nail. The ancients, as we have seen, gave this name to different stones presenting parallel bands, straight or curved, of two colours, such as are seen on the human nail; so that whatever be the origin of the name Sarde, it is evident that the Sardonyx must have been a stone of two colours, the one white and the other some shade of red or brown, though now the name of *Onyx* seems more particularly applied to those black Agates which have a white band.

At present, as in the days of Pliny, the Fakirs of India wear long chaplets of Sardonyx, of Onyx, and other Agates, the stones being some of them very large. The ancients called those which were bored *Indian Sardonyxes*.

Scipio is said to have been the first Roman who wore the Sardonyx, which he did in a ring. That precious ring which Polycrates, tyrant of Samos, threw into the sea to defy fortune, that had so long befriended him with unheard-of prosperity, was a Sardonyx. He intended, by this foolish act, to shew the world that after such a loss no misfortune could have power to move him. The story adds, that he afterwards recovered his ring, it being found in the stomach of a fish that was given to him. Onyxes must have been much more common, since Mithridates is said to have possessed four thousand cups of this stone. It is probable they were different banded Agates and other stones, though the Onyx is much more common than is generally believed; the difficulty is the finding such as are large and perfect. The lapidaries, it is said, produce them artificially by

boiling certain Agates first in oil and then in sulphuric acid. This process, however, can only produce such as are black and white.

Stones of this kind have been extensively engraved, and the antique Cameos are much sought after, and fetch enormous prices. There existed in the Cabinet of M. de Dree, a Sardonyx of five different layers or bands, white and of a chestnut-brown; it was cut as a Cameo, and represented the Bust of Faustina, wife of Anthony the Pious. This stone, which was of an oval form, sixteen lines in length and half that in breadth, was sold at public sale for £296. Another Oriental Onyx, belonging to M. de la Reiniere, is said to have cost £416; it consisted of three yellow-brown bands and two intermediate white ones. The shape of this one also was oval, being two inches long and ten lines broad. M. Leyman mentions having seen an Onyx of twice this size, for which £1250 was asked; but there is one in the Cabinet of Dresden, which is four inches square, and is valued at 44,000 dollars.

One of the finest engraved stones of this kind is that which represents the Apotheosis of Augustus. This is in the National Museum at Paris; it is eleven inches long and nine broad. Another is also mentioned, exhibiting the Apotheosis of Ptolemy on one side, and the head of Medusa on the other; both are splendid specimens of the art. The former is by some supposed to be the largest in existence. But the most noted of the ancient Cameos is the Mantuan Vase at Brunswick. It was cut from a

single stone, and has the form of a cream-pot, about seven inches high and two and a half broad; on its outside, which is of a brown colour, there are white and yellow groups of raised figures, representing Ceres and Triptolemus in search of Proserpine.

In the fifteenth century, many vases and cups were made of Onyx, but though beautiful productions, they are not of the fine quality for which the precious Sardonyx is admired. The Spanish Crown is said to possess fine objects of the kind I am speaking of. Onyxes are found in abundance, and in large pieces, in the deserts of the Nogaï Khirghiz, where they are ~~it is~~ collected. Niebuhr says many of these stones are found in Yemen. Ayesha, the well-beloved wife of Mohammed, is said to have possessed a very fine necklace of Onyx.

But I fear that this letter is already extremely long. I was anxious to give you what information I could respecting the Onyx and Sardonyx, both on account of the esteem in which they are held, and of a certain confusion which exists among these stones and their names. I shall, however, now conclude by telling you how the poets set about giving a divine origin to the Onyx.

One day, say they, Cupid finding his mother asleep performed for her the office of our chiropodists, and cut her nails with the blade of one of his arrows and then flew away; the parings fell upon the sand of the coast of India, and as nothing which proceeds from a divinity can perish, the Fates carefully gathered them up, and changed them into those stone called *Onyxes*.

The fable, I confess, is not very complimentary to the goddess of beauty, as it would seem to indicate that she made some unworthy use of her nails, which forced Young Love to shorten them. But we must not go too deep into such matters: so, leaving you to your own meditations on the subject, I shall for the present say, Adieu!

LETTER IX.

Chrysoprase—Plasma—Heliotrope—Fable of Clytia—Variegated Agates—Fortification Agates—Eyed Agates—Ribbon or Banded Agates—Iris Agate—Gamahées or Figured Stones—Ruin Marble.

THE Silexes comprising a great variety of stones differing in appearance, and all more or less interesting, you must not, my dear Florence, be surprised to find that I cannot exhaust the subject in one or two letters. Having spoken to you of Calcedony and Cornelian; of the Onyx, the Sardonyx, and the Calcedonyx, I shall now proceed with the other Agates; and, first, of the *Chrysoprase;* a stone which, in my estimation, is far more beautiful than those already mentioned, when considered in itself independent of workmanship, which constitutes nearly the whole value of the Onyxes, &c.

The CHRYSOPRASE is merely a variety of the Calcedony, somewhat less hard, though of greater density than the colourless variety. Its texture, however, is equally fine and it has the same semi-transparency. It is distinguished by, and sought after for, its beautiful colour, which is a fine apple-green in the choice specimens, though it exhibits other tints, as grass-green, pistachio-green, and greyish-green. It is sometimes spotted with yellowish brown; but it is only when the colour is a fine rich apple-green, and equably distributed throughout, that this stone is really valued. It is then encircled with diamonds or pearls, producing a very charming effect, which is

rather enhanced than otherwise by artificial light. It is rare to find perfect specimens exceeding an inch in diameter. Its price, for a mere Agate, is rather high. M. Brard informs us that an oval Chrysoprase, of a fine colour and of about eight lines in diameter, was sold for £13. Jameson says that a perfect stone of this kind, fit for mounting in a ring, is worth from £10 to £20. Unfortunately, the Chrysoprase loses its colour after a time, particularly if kept in a warm place; it is recommended to keep it in damp cotton. This method, by the way I may observe, should not be employed if the stone is surrounded with pearls, as these latter would thereby be injured. Pearls should be kept in dry hair-powder.

The finest pieces of Chrysoprase are made into necklaces, bracelets, clasps, brooches, ear-drops, &c., and the least perfect and larger specimens into snuff-boxes, seals, cups, &c. The Chrysoprase has hitherto been found almost exclusively in the principality of Munsterberg, in Lower Silesia, in the neighbourhood of the towns of Glassendorf, Grochau, and Kosemutz. Frederick the Great particularly encouraged the search for and working of this stone, of which the finest specimens are from the mountain of Glassendorf, which is a rock of Serpentine containing Asbestus, Talc, and Lithomarge. There are five slabs of this mineral in the cathedral of Prague.

The name Chrysoprase was given by the ancients to a stone of a yellowish-green colour. Leyman was the first to apply it to the stone now known under that name, which some think inappropriate, though if we translate it by *yellow-green*, I think it perfectly suitable; the colour is due to Nickel.

Following still the arrangement of M. Leyman, I shall now leave the Chrysoprase and call your attention to other green Agates, respecting which there is much confusion.

Plasma.—The real Antique Plasma is a rare stone, which has only been discovered in the ruins of Rome. It is of a dark green, and almost black when unpolished and seen by reflection; but when held between the eye and the light it is very translucid. It is sometimes homogeneous and sometimes cloudy, and its colour varies from a yellowish green to a leek-green, and emerald-green. It differs from Heliotrope, of which we shall speak presently, by not being susceptible of so brilliant a polish, by its great translucidity, and by the absence of spots of different colours. These two latter characteristics distinguish it from Green Jasper or Blood-stone, which is opaque and spotted with red. The *Silex Jadien* of Dolomieu somewhat resembles it, only it is of a paler green and has a greasy polish like the Jade itself. All these stones owe their colour to iron, which distinguishes them from Chrysoprase, whose tint, as we have seen, is due to the oxide of Nickel.

The locality of the antique Plasma is not known, the ancients procured somewhat voluminous specimens of it, and Pliny assigns it a place among the twelve varieties of *Smaragdus*. Its name appears to be a corruption of *Prasma*, derived from *Prason*, the Greek name of the leek. Certain nodular green stones, of a somewhat similar nature, found in a mountain of Serpentine at Bayanowitz, in Moravia, along with Hornstone, are by some assimilated with Plasma, and similar stones are also said to be found

in Hungary and in some parts of Italy; but it is doubtful whether these stones are the true Plasma, which is often confounded with varieties of Prase, of Jade, and even of translucent spotted Heliotrope; all of them being occasionally substituted for it. Jameson, however, assures us that real Plasma is found at the foot of Mount Olympus, in Asia Minor, associated with the green Calcedony of Klaproth, and that it has also been found in the *Sierra de Guadaloupe*, in Spain. The ancients wrought it into various ornaments, and have extensively engraved it both *in intaglio* and *in relievo*.

HELIOTROPE.—The stones which go under this name are some of them Agates and others Jasper. The distinctive characteristics of both is the having red spots upon a green ground. The green of the Agate Heliotrope, however, is rather bluish, and the stone is transparent at the edges, which completely distinguishes it from the *Jasper Blood-stone*, this latter being essentially opaque. According to Patrin, when the transluced parts are greater than the opaque ones, the stone is an Agate-Heliotrope; and when, on the contrary, the opaque predominate, it is a Jasper-Heliotrope. The former of these bears considerable resemblance to a Calcedony, both in its nature and from its locality. Its colour, which it loses by heat, is supposed to be due to green Chlorite.

The finest Heliotropes (including both kinds under the same name) come to us from the Southern parts of Asia, but they are also found in Sicily, Sardinia, Bohemia, Transylvania, Ireland, Scotland and Siberia. They were well known to the ancients, who received them from Ethiopia and Cyprus.

In the early days of Christianity this stone was much used for the engraving of holy subjects. Thus in the National Collection at Paris may be seen a Head of Christ flagellated, cut in Heliotrope; the drops of blood being represented by the natural red spots of the stone; the reverse of these engraved stones often represented an image of the Virgin. Horoscopes and other subjects have also been engraved on both kinds of Heliotrope, but the stones so cut are not of very high antiquity. At the present time the Heliotropes proper, and the Jasper Blood-stones, are worked into a variety of small objects, as boxes, seals, ring-stones, &c., which are so much the more valued as the body colour is more agreeable and uniform, and the spots well distributed and of a bright red. I once possessed a specimen from India thickly sprinkled with white, yellow, and red spots, of the size of a pin's head, and perfectly round, the ground colour being a fine dark green. All the Heliotropes take a high polish.

M. Patrin tells us that the name *Heliotrope,* or Turnsol, was no doubt given to this stone (the agate variety) because, in looking at the sun through it, the irregularity of the translucent parts produces the effect of a turning of the sun's rays. This, between ourselves, seems rather fanciful and far-fetched, I therefore give it you for no more than it is worth. Pliny tells us it was called Heliotrope because it was used for looking at the sun, as we use smoked glass. This reason seems no better than that assigned by Patrin, for the ancients could certainly have employed for the purpose many more fitting stones. In another passage, this same Pliny

says, that if Heliotrope be thrown into a vase of water, the rays of the sun falling upon the water appear of a blood-red colour, and that out of the water the stone represents the sun, and is used to observe eclipses of that body. The ancients attributed to the Blood-stone a great many virtues, among others, that of stopping hæmorrhage, and of rendering the person who wore it invincible.

This name of Heliotrope will, no doubt, call to your mind one of your favourite flowers, and as you may probably like to know why it also is called Heliotrope, I will make a momentary digression in order to satisfy your curiosity.

You must know, then, that Clytia, daughter of Oceanus and Thetis, was beloved of Apollo, who, after a while, left her for her sister Leucothoë. Clytia, upon discovery of this infidelity, destroyed her sister, after which Apollo shewed her nothing but contempt. Rendered desperate by this conduct of the god, the unhappy Clytia resolved upon letting herself die of hunger. Reclining on the ground with her hair dishevelled and her gaze constantly fixed upon the sun, she remained till Apollo (whether from pity, or to avoid the importunity of her imploring regard, fable sayeth not,) changed her into the flower called *Heliotrope,* or *Turnsol.* So sings Ovid, but one of his translators has understood the fable as alluding to the brazen-faced *Helianthus*, or *Sun-flower.* You, my dear cousin, have my free permission to apply the story to whichever of the two plants you please, though I think it belongs of right to the first.

I am now to say something of those pretty pro-

ductions, the variously-coloured Agates, with which I shall conclude this letter and the subject of our first division of the silexes, or those of a fine texture.

Variegated Agates are those known generally by the single name of *Agates;* they partake at the same time of the nature of the Calcedony and the Cornelian, &c., whose several colours are blended in their mass. These colours are distributed in different ways, but generally in parallel zones, sometimes of extreme thinness. The appearance of the cut and polished Agates is very various, sometimes owing to the way in which the stone has been formed naturally, and sometimes to the manner in which it is cut.

In order that you may understand how the appearance is affected by the mode of formation, you must know that almost all the Agates occur in more or less regularly rounded forms either in the cavities of the trap-rocks or lavas, or else detached and scattered over the surface of the soil, or in the beds of torrents and rivers. Now as the cavities in which the Agates are formed are not always regular in shape, and as the stony matter is not always deposited in a uniform manner over the whole of the interior surface of these cavities, the Agates which are moulded in them must be modified by these circumstances. Hence arises the varied and sometimes grotesque convolutions assumed by the successive deposits which constitute the Agates. When the cavity is of a rugged shape, having many protuberances and ins and outs, and the stony infiltration takes place uniformly over the whole of its inner surface, the layers of deposited matter will not only be concentric and parallel to the external surface of the Agate, but

when this is sawed in two, the appearance will be that of a number of salient and re-entering angles, such as may be seen in the plan of a fortification, whence such Agates are called *Zig-zag* or *Fortification Agates.*

Some Agates seem to have been formed by a bundle of cylinders enveloped in a siliceous paste, the cylinders themselves being formed of concentric accumulations. When such an Agate is cut in a direction perpendicular to the cylinders, it exhibits a multitude of circular figures bearing some resemblance to the iris and pupil of the eye; whence this kind is called *Eyed Agate;* but if the stone be cut in a direction parallel to the axes of the cylinders we have a suite of more or less delicate parallel lines, in which case it forms a *Ribbon or Banded Agate.* The same stone, cut at any angle to the axes of the cylinders, will shew a number of ovals and other curves. Thus you see that nature and art combine to produce variety in the aspect of the Agates. The cylinders of which I have just spoken, are, in fact, so many siliceous stalactites and stalagmites found in the cavities of the lava, in the same manner as the great calcareous stalactites of which I before spoke to you are formed in the caverns of lime-stone rocks. Agates are not always solid; they are indeed more generally geodes or hollow balls, having their own cavity frequently lined with fine crystals of colourless Quartz or of Amethyst.

According to the different aspects of Agates they are known by the names of *Eyed Agates*, or *Banded* or *Ribbon* or *Onyx*, or *spotted* or *mottled, veined, figured, dendritic, jaspoid*, &c. The colours of the

Agates are extremely varied, and sometimes very bright. Some of the veins are transparent, some translucid, and some quite opaque.

One of the most interesting varieties is that called the *Iris Agate*. It is formed of infinitely thin layers, of a milky Calcedony, alternating with others of coloured agate. When this variety is cut into thin slabs perpendicular to the layers, it forms a finely striped Agate, which, being held under a certain angle (easily found) between the eye and the light, shews a succession of the most beautiful rainbow series of colours often repeated. The texture or substance of this Agate is exceedingly fine, and it accordingly takes a very brilliant polish. In some Agates the stripes are so minute that if the stone be properly cut for the purpose, there is seen a play of light similar to that produced by the *Cat's-eye*, though less vivid.

Agates are found in several countries, particularly in Sardinia and Sicily, in Scotland, and at Oberstein; as also in India and elsewhere. Many very pretty objects are made of Agate, such as necklaces, ear-drops, brooches, clasps, rings, buttons, seals, handles for knives, poignards and sabres, vases, cups, boxes, &c. It is also used for small mortars, on account of its hardness, and for cups for the pivots of marine compasses. In Italy it is much employed for Mosaic work; but nowhere, perhaps, have Agates been so largely employed, and with such excellent effect, as at Agra, in the decoration of the celebrated Mausoleum of the favourite wife of the Mogul Emperor, Shah Jehan.

This unique monument is internally surrounded

with borders in the form of garlands, of exquisite taste, entirely composed of Agates, Jasper, Cornelian, Lapis-Lazuli, &c. The stones being let into the white marble in the manner of the Florentine Mosaics. Externally the edifice is adorned in like manner, but with coloured marbles and jaspers. All the Agates, &c. employed, are said to be the produce of different countries of India, and are of the finest quality.

Agates, in general, are more or less esteemed according to the fineness of their paste, the beauty of their colours, the agreeable or curious forms of their markings, and their distinctness.

Some Agates are very curious, in as much as they represent, frequently with remarkable accuracy, faces, figures, and other objects. These were formerly called *Gamahées*, or *Gamaheus*, in common with all other naturally figured stones, whether the figures were concave or in relief, or naturally drawn or coloured. Pliny speaks of an Agate belonging to King Pyrrhus which represented the nine Muses with Apollo in the midst holding a lyre; the whole being most perfect, though a mere freak of nature. Majolus informs us that there is in Venice an Agate on which is the figure of a man thus drawn by the hand of nature. It is also said that in the Church of St. John, at Pisa, there is a stone of the same kind, representing an old hermit in a desert, seated on the banks of a stream, and holding in his hand a little bell, just in the way St. Anthony is generally painted.

A friend of mine, in Scotland, possessed a very curious Agate, about an inch long, of an oval form,

on which was the most admirably perfect representation of the sun setting beneath the sea. The lower half of the stone was in parallel lines of light grey, blue and white interspersed, in the way calm water is painted. On the upper edge of this and exactly in the middle, was seen half of the sun's disc, from which rays diverged, filling up the rest of the stone. But the most remarkable Agate of this kind I ever saw, was in the possession of the Dominicans, in one of their convents abroad. It represented a most admirable portrait of Louis XVI. in profile, with a blood-coloured crescent-formed streak right across the throat. There were also other marks having allusion to that monarch, but which I do not now remember.

These singular accidents are not, however, peculiar to the Agates. There is in the British Museum an Egyptian Jasper broken in two, and on each piece is a profile of Chaucer the poet. In the temple of St. Sophia, at Constantinople, there was formerly seen on a slab of white marble, an image of St. John the Baptist, clothed in a camel's skin; it was defective—nature had given the Saint but one leg to stand upon. At Ravenna, in the Church of St. Vital, there is the natural figure of a Cordelier on a grey stone. It is said, that some time after the Passion of our Saviour, there was found in Italy the figure of a crucifixion, so admirably represented on a piece of marble, that the nails, the wounds, the drops of blood, and all the details, were as perfect as the best painter could have executed them. This figure, if we may believe Gafferel, is still at St. Gregorio, in Venice. Among the jewels of a Margrave of Baden

there was a precious stone, which shewed a crucifix whichever way it was turned. At Schneeberg, in Germany, there was found in a mine, an unpurified piece of metal, on which was the figure of a man carrying a child on his back, as St. Christopher is represented doing. In Provence there was discovered, also in a mine, a quantity of figures of birds, trees, rats, and serpents (perhaps these were fossils). Lastly, in crossing the western frontier of Tartary, there are seen upon the rocks several Gamahées of camels, horses, and sheep (these may be the weather-worn remains of ancient sculptured rocks). The *Ruin or Landscape Marble* so common at Val-d'Arno, near Florence, and which is also found near Bristol, may be regarded as a kind of *Gamahée*, since it represents, sometimes with great fidelity, towers, castles, pyramids, obelisks, columns, and ruins of all kinds; sometimes with dendrites looking exactly like trees and shrubs growing out from the midst of the old walls and scattered fragments. But all these freaks of nature, however pretty and curious they may be, are mere accidents, and much less interesting to the real lover of nature than her regular and constant productions. In this, as well as in many other cases, the epithet of Wonders of Nature has been bestowed upon what are indeed but her vagaries and monstrosities: the real wonders are those which testify to an order that can result only from the Supreme Intelligence.

LETTER X.

Silex Jadean—Silex Prasean—Hornstone—Flint—Ferruginous Flint—Flint and Steel—Gun-flints—Lighting of Mines by means of Flint—Buhr, or Mill-stone—Float-stone—Silici-calx—Silex in Straw.

THE division of the Silexes, of which I am now about to speak to you, will probably not have the same interest with the generality of ladies as that of which I have already treated, since the Minerals which compose it are none of them used for the adornment of the person, nor even (with one exception, the *Silex* Jadean) are they employed for the cabinet or the boudoir. But although the beauty and brilliancy of a stone have certainly their value, the correctness of your judgment will, I am persuaded, induce you to consider these advantages, particularly if they are the only ones possessed by a mineral, as very secondary when compared with the important services rendered to us by certain stones of a much less seductive appearance.

The beneficence of Providence has not only supplied man with what is necessary for him, but also with what is agreeable. While, however, we admire the cerulean corn-flower and the scarlet poppy which adorn the fields, it is the dun corn itself that excites our interest and inspires our gratitude. It is the same in the mineral kingdom. Without ceasing to be gratified by the brilliancy of the gems, the purple tint of the Amethyst, the golden yellow of the Topaz, the celestial blue of the Sapphire, the soft green of the Emerald, the fire of the Ruby, or the resplendent

refraction of all these colours together in the Diamond; we look with a much deeper interest on the dark brown ore of iron, or the black coal, two of the richest presents of heaven to earth. And if, in walking among the fields, the abundant corn interests us more than the few gaudy flowers that are dispersed among it, so the stone which serves to grind it for our daily sustenance must appear more precious to us than those minerals whose only merit is their beauty. The Buhr-stone is the most important of the group we are about to consider; but let us follow M. Leyman's order, which we have adopted. The second division of the Silexes, then, is that of the coarse-textured variety—and first of

Silex Jadean.—Of all the coarse-textured Silexes this approaches the nearest to the Agates; its general colour is a yellowish green, from which it passes to whitish and greyish; its fracture is conchoidal, sometimes rough and sometimes smooth, occasionally shining. That variety which has the conchoid and smooth fracture of flint, is employed by the Italians under the name of *Plasma,* for engraving on, and some specimens are found of an inch in diameter, of good and uniform colour, fit to form seal or ring-stones.

Silex Prasean.—This stone differs but little from the last-mentioned; its fracture, although conchoidal, is splintery, rough, and even granular in some places; its colour varies from a very pale yellow-green to a pistachio-green; it also passes into reddish and grey. The first kind is found at Monte Ruffoli, near Volterra, in Tuscany, and the second at the island of Elba.

These two varieties, the *Silex Jadean* and *Silex Prasean*, have been established by Dolomieu, and are admitted by other mineralogists. They both differ essentially from Jade and Prase. Jade is of a different colour, has a more greasy appearance, is harder and more fusible, and Prase has a vitreous fracture. Neither the Silex Jadean nor the Silex Prasean are, however, of sufficient importance to detain us longer.

HORNSTONE.—This variety is found massive, in nodules and pseudomorphous, and of almost all colours—red, yellow, white, grey, blueish, green, &c., though these are usually pale. It derives its name from its semi-transparency, but more particularly from its fracture, which resembles that of horn or of wax. This fracture is conchoidal, but with numerous scales, which assume a grey colour that contrasts with the ground-colour of the stone. It is very hard and difficult to break, having a certain toughness; its aspect is generally dull, though sometimes it has a glimmering lustre. In appearance it closely resembles compact Felspar, but while the latter is fusible, Hornstone is not. The fragments are sharp-edged. M. Leyman divides Hornstone into three sub-species—scaly hornstone, conchoidal hornstone, and coarse hornstone. These names sufficiently indicate their characteristic difference. The two former of these sub-varieties are found in primitive mountains, where they form thick veins enclosing ores of silver, lead, zinc, copper, and iron. They are also met with forming veins and large masses in calcareous rocks and in certain porphyries.

Hornstone, Quartz, Agate, Jasper, and Calcedony, often present themselves together in the same vein,

and not unfrequently pass into each other. The mines of Saxony, Bohemia, Norway, Sweden, and France, all contain Hornstone. The silver-mine of Zmeof, in the Altaï, and many other mines, such as those of the Ural Mountains, have a Hornstone for their gangue. The finest pseudomorphous Hornstones are found at Schneeberg, in Saxony. In the lead-veins of Huelgoet, in Brittany, is found a Hornstone of a fine calcedony whiteness with grey veins.

The third sub-variety of Hornstone is brown or greyish, seldom reddish. It forms bands or beds, in sands and marls, as at Passy, at St. Cloud, and Mount Valerien, in the environs of Paris.

Some specimens of Hornstone are very beautiful. Thus I have seen many among the boulder-stones in Poland, which would have furnished very fine slabs. There is, I am sorry to say, much confusion in the stones named Hornstone. One of them is that used for the sharpening of lancets.

Flint.—Although this stone be known to every one, that should not prevent our considering it mineralogically, and entering into some little details respecting it, as we have done for other less useful productions. The fracture of Flint is perfectly conchoidal, sometimes smooth, sometimes dull; in the first case it is harder than Quartz, which it scratches. Its colour is various shades of grey, passing to black on one side, and to nearly white on the other, and brown. Two pieces rubbed together in the dark emit a phosphoric light and a peculiar odour. It is infusible, but whitens and becomes opaque by heat, is more or less translucent, and the edges of the fragments more or less sharp, according to the varieties.

Our gravel is chiefly composed of Flints, and as many of these are yellow, and called *ferruginous flints*, they are supposed by some to acquire that colour from long exposure to the action of air and water. I cannot, however, adopt this opinion, for we find flint employed in masonry of many centuries' old as black as when first broken.

Brongniart divides Flints into three varieties, which are, however, distinguished more by their locality than by their external appearance. These varieties are the *brown*, the *light-coloured*, and the *jaspoid* or *jaspered*. The first two of these are usually found embedded in chalk, though the second more especially, in compact lime-stone; its fracture is more shining than that of the first. The Jaspered Flint is generally of a whitish yellow, marbled, banded, veined, or spotted, and very much resembles a Jasper; from which, however, it differs by its shining fracture and its translucidity. Flints are generally found in nodular masses, of various sizes, and most irregular and often very grotesque forms, distributed in more or less continuous and parallel lines or beds, chiefly in chalk. When met with in the crystalline rocks they form no part of these, but have been accidentally deposited as rolled stones in their cavities and veins.

Alluvial soils of immense extent are sometimes almost wholly composed of rolled Flints. It has been asserted that broken Flints, after a time, become covered with a new crust, white, opaque, porous and absorbent, which has led to the belief that Flints decompose and become chalk; but the same reason I have already given against the effect of air and water

in turning Flints yellow, applies here. As, however, Flints that have evidently been broken are thus occasionally found in the fields covered with the white crust in question, I am inclined to suppose this to result from the action of the acids and salts the Flints meet with in the soil; though I merely mention this as a crude idea not worth dwelling upon.

The interior of the geodes of Flint is often lined with crystals of quartz, with carbonate of iron, sulphuret of iron, siliceous stalactites, &c. Finally, Flints are usually moist in their interior when first extracted from their beds.

The formation of Flints has much puzzled the geologists, but I cannot here detail the various hypotheses they have imagined.

Flints are found in the North of France, on the coast and in the interior of England, in Denmark, Saxony, Poland, Spain, and elsewhere.

Flints reduced to powder (by being first calcined, then thrown into cold water, and subsequently pounded,) enter into the composition of fine earthenware. In their rugged state they form a very excellent building material, taking good hold of the mortar by reason of their form, and being, so to say, indestructible. Broken by a particular process into thin fragments of a peculiar shape, they form gun-flints, the use of which is now in great measure superseded by what are called percussion-caps.

It would seem as though Flints were intended by nature to serve man in his wars (for it cannot be denied that war is in the nature of man), since long before the invention of gunpowder he made himself arms with Flints. Thus the ancient Gauls made

axe-heads, knives, poignards, spear and arrow-heads, of Flint. Many of these ancient weapons are found in the neighbourhood of Perigueux, in France, and they are so perfectly fashioned that even in the present day, with all the advantages we derive from improved processes and machinery for cutting and polishing hard stone, we can make nothing more complete of the kind. It is believed that the knives used by the Hebrews in certain ceremonies were of Flint, others say obsidian, and that the name of Silex is derived from the Latin *scindere*, to cut off.

There is in the *Annuaire du Département de la Dordogne*, for 1819, a very interesting dissertation by M. Jouannet on the weapons of flint, and the excellent work of M. Brard also contains an account of these objects. This latter author observes: "It is worthy of remark that this same stone which armed the hands of our forefathers, this same Flint which, with much pains, they fashioned for the chase and for war, the same Silex which in the heroic ages was replaced by weapons of bronze and iron, has been again torn from the bowels of the earth to reappear in the midst of battle and carnage, completing, so to say, the fatal discovery of gunpowder." Since this was written, however, the fulminating capsules have taken the place of Flints in European armies, and cotton, as you may lately have heard, will kill as well as gunpowder.

There was formerly, and, for all I know, there may still be at Brzeczan, in Gallicia, a celebrated manufactory of gun-flints supplied by the flint-stones of Podgozze. France for a long time supplied other countries with gun-flints, but their exportation was

subsequently forbidden. England made Flints for herself, and they are also made in the Tyrol, in Portugal, and elsewhere. At Oberstein, Agates are cut and polished as gun-flints, and were at one time used by sportsmen and gentlemen for their fowling-pieces and pistols. It appears from various different statements, that upon an average a good workman can make about 500 flints in a day.

All this, my fair cousin, you will say, is fitter to be known by a soldier than by a woman: this is very true, and I therefore intend it rather for your brother, whose destiny it is to wield arms, and to whom therefore I beg you will communicate it. You must however remember, that if Flints were used in aggressive warfare, they were also used for our defence—also in obtaining game for our table, and, before the invention of lucifer-matches, for obtaining fire to cook it with.

The common operation of striking fire with flint and steel, simple as it may appear, is not understood by every one. But first you must know that, according to Pliny, Clias was the first who struck fire from the Flint, and who was accordingly named *Pyrodes*. Well, then, when a flint and steel are struck together to set fire to tinder, which is still done by many a cottager's goodwife, the result is a quantity of sparks and little brilliant coruscations like little stars. In order to know what these really are, let the blows be given over a sheet of paper, and then examine with a magnifier the small particles that have fallen on the paper: you will find them to be of three kinds. First, minute splinters of the Flint struck off by the blow, and which remain un-

altered; secondly, little chips of steel of an irregular form, but also unaltered; and thirdly, small round bodies ten times smaller than a pin's head: these latter have the appearance of a scoria or cinder, and, being hollow, may be crushed with the nail like little globes of glass. These have generally been taken for little bullets of melted iron, but M. Brard suspects them to be a combination of silica and iron, a true scoria, attractable by the magnet; the heat produced by the blow being sufficient to heat the steel-chips red hot, and effect the combination of the silica and iron in the smaller molecules, which are those that coruscate in little brilliant stars with a hissing noise.

I am sure when you consider for how many ages we have been indebted to Flint for fire and light, you will forgive nature if in this, as in many other cases, she has not given us altogether an unalloyed good; or rather you will say, Providence made the Flint a reservoir of fire for man's need, but man has turned against himself to his destruction what was intended for his advantage. Nor has the fabrication of gun-flints been injurious in actual warfare only, for it has been found by experience, that the workmen who prepare them, die generally at twenty-five or thirty years of age, of consumption brought on by the constant inhalation of the flinty dust.

But, my dear Florence, I really fear you are by this time heartily tired of all this prosing about common Flints; I will, therefore, only say one word more respecting it.

You have heard of the dreadful explosions which take place in certain mines from the accidental firing

of detonating gas, engendered and accumulated in them. These explosions take place whenever a flame is brought in contact with this dreadful gas, and accordingly the miners cannot use candles without certain precautions. It was reserved for the celebrated Sir Humphry Davy to add one more to the many cases in which science has been practically applied for the saving of human life, by the invention of a lamp, called from him, Davy's Safety-lamp. To describe it would be foreign to my present purpose. Before his invention, however, and even now, I believe, in some places, the danger was avoided by other means. A large steel-wheel was made to revolve with rapidity against a large silex or flint, the long and thick train of sparks from which, gave the miner light enough for his labour, without any danger of exploding the gas.

Buhr-Stone, or Mill-Stone.—This variety of silex is of the greatest importance, from the use that is made of it, a use which its name will have already indicated. Of it the finest mill-stones are made. The Buhr-stone is of two kinds, the cellular and the compact. This division is, however, not a good one, as both kinds are cellular; the difference being, that one kind is not composed of small and regularly distributed cells, but has large cavities and is also softer. This latter kind, that is the softer, is unfit for mill-stones, but it is employed with advantage, when very rugged and full of holes, for artificial rock-work and ruins in landscape-gardening. Its numerous cavities and warm colour are peculiarly suited for picturesque effect.

It would be out of place to speak to you here of

the origin of the pleasure we derive from the contemplation of ruins, and which induces us to imitate them, by employing stones which appear corroded by years and the elements. Perhaps we consider them with relation to ourselves, and derive a kind of consolation in the reflection, that if time makes such havoc with frail beauty, which it so soon destroys, neither does it spare the most solid edifices nor the hardest rocks, which it at last levels with the dust. The proudest of our monuments prolong the memory of our existence but a few short years, and we seek for immortality among men! . . . . . But forgive me, dear cousin, this short digression. Every one, you know, has a certain train of thought peculiar to himself, and which, like a vortex turning on itself, seizes and appropriates whatever comes within the sphere of its activity. The filiation of ideas is a most intricate subject, and the thoughts most opposite in appearance have often a very close though at first unperceived connexion; and thus it is that in speaking to you of a stone employed in the preparation of flour for the sustenance of life, I have stumbled upon thoughts of mortality. Let us therefore haste to quit the gloom-inspiring ruins, whether real or artificial, and turn to the quarries of La Ferté-sous-Jouarre. It is here, in the departments of Seine and Marne, that the finest quality of Buhr-stone is found, though it is also met with elsewhere, as at the Turkish Island of Milo, at Conway in Wales, and in some parts of Scotland. The best kind for millstones is that in which the cavities or pores and the solid parts are in equal proportion and equably distributed throughout the stone. Now this, with the

requisite degree of hardness, is found particularly at La Ferté-sous-Jouarre; and you may judge of the importance of the stone here quarried when I tell you that a single mill-stone in one piece, of six feet diameter, sells for 1200 francs, or about £50, and if formed of several pieces, for 800 francs, or £33.

This variety of Silex is found in beds or detached masses of various thickness. When the mass is large, it is cut out into the form of a huge cylinder; this is then marked off by grooves, distant from each other according to the thickness required for the mill-stones (about eighteen inches), into these grooves several wooden wedges are driven, upon which water is thrown. The wood swells in consequence, and splits the cylinder into the slices required. When the mill-stones are formed of different pieces, these are bound together by strong iron-hoops. Though other stones, as certain siliceous grits, or sand-stones, and even granite, are used for mill-stones, the French Buhr is reputed the best of all for corn-grinding, particularly for wheat and rye. It is dear, but extremely durable.

Float-Stone —This stone is composed of a number of very minute crystals, giving to the mass a spongiform or cellular texture. The air confined in these cellules enables the stone to float for a while on water. It is found at St. Ouen, near Paris, in beds of chalk, as also on the banks of the Seine, and elsewhere; it is only remarkable for its lightness.

Calcareous Silex.—This variety, called by Leyman *Silex Calcifere*, or *Silicicalx*, is a mixture of Silex and Lime. It is a very interesting mineral in a scientific point of view. The finest specimens are

those I have already mentioned to you as the *Crystallized Sand-stone of Fontainebleau.* I would not have mentioned it here but as completing the list of the Silexes as given by Leyman, whose arrangement of them we have been following.

Before closing this letter, I must inform you that, besides such particular modifications of the siliceous earth as we have been considering, it forms sixty-two parts in every hundred in the composition of wheat-straw, and fifty-seven parts in that of barley. Thus, my dear Florence, I trust that henceforward you will never see flint and steel struck without remembering that Silex gives to the stalk of wheat the rigidity necessary for supporting the weight of the ear, that Silex is employed for reducing that ear into flour, and that the same Silex procures us the fire necessary for baking that flour into bread, the staff of life. How many fresh reasons for wonder and gratitude do we not find at every step we take in the study of nature! May you never tire of it, as it is the only one whose fruits are ever in proportion with its cultivation.

LETTER XI.

Silex Resinite—Opal—Hydrophane, or Oculus Mundi—Pitch-stone—Menilite.

THE observation of nature proves to us, my dear Florence, the existence of a most admirable distribution of the useful and the agreeable frequently blended together in the same object, and when separate, we find each of these qualities so perfect in itself as to interest us without requiring the aid of the other. Thus among animals, we admire in the Arabian courser beauty of form, docility of character, and great speed, rendering him at the same time as useful as he is beautiful. On the other hand, if beauty has been denied to the elephant and the camel, the great strength and superior intelligence of the former, and the indefatigable perseverance and powers of endurance of the latter, are more than sufficient compensation. The brilliant plumage of the peacock atones for the harshness of his voice; and notwithstanding his inutility, he is sought after and admired for his rare beauty.

What is true of animals is equally so of vegetables and minerals. Among plants, as you well know, the greater number unite the beauty of form and colour, or the gift of fragrance, to eminent usefulness; but there are also some that have nothing but these exterior advantages to recommend them, while there are others which, less favoured in this respect, are endowed with the most important virtues, or are susceptible of being applied to most useful purposes.

It is the same with minerals. I gave you in my last an example, in the case of the Buhr-stone, of a Silex having no beauty whatever to recommend it, but of the greatest utility; and now, to diversify my letters, as nature herself diversifies her productions, I will entertain you with some account of the third group of Silexes, according to M. Leyman, which will recommend itself to your attention by the great beauty of at least one of the varieties of which it is composed.

Silex Resinite.—This name is given by foreign mineralogists to a species of Silex which has a resinous appearance. Its fracture is conchoidal and shining, like that of rosin, and the edges of its fragments are extremely sharp. Such are the distinctive characteristics of this remarkable group of Silexes. This Silex is moreover easily broken, and is much less hard than the other siliceous minerals, so that it never takes a very brilliant polish. It passes from almost perfect opacity to semi-transparency. It includes several varieties, the most interesting of which is the

Opal.—This gem is highly deserving of admiration for its extreme beauty, a quality, by the way, of whose fragility the Opal is a natural emblem, as it is most easily destroyed.

Lapidaries recognize the following varieties of Opal:—

The *Noble* or *Oriental Opal.* (Before proceeding further, I must tell you that this name of Oriental, as applied to gems, &c., does not of necessity imply that they come from the East, but is a conventional term implying perfection.) The Noble Opal is of a bluish or yellowish-white colour, and

is yellow by transmitted light. It exhibits flashes or flames of the most brilliant colours.

Harlequin Opal.—In this sub-variety the colours are equally beautiful with those of the Noble Opal, but they are disposed in detached spots.

Girasol.—This kind is almost transparent, but shews a bluish light, coming, as it were, from the interior of the stone.

Dark or *Blackish Opal*, which shines with the colour of a red-hot coal going out.

Prime d'Opal.—This is nothing more than grains of Opal thickly distributed in a dull earthy gangue, usually of a reddish-grey colour.

In some varieties of Opal the separate characteristics of some of the above are blended together. Thus I remember to have seen a very beautiful Opal, of nine lines by six, which had longitudinally three distinct bands of the Harlequin kind, from the uppermost of which rose perpendicularly the most resplendent flames. It was set as a ring-stone surrounded with brilliants. It belonged to my friend the late Starost of Bransk, Count M— S—, and was known to the virtuosi of Vienna and Dresden, where the Count often resided, as the third most beautiful Opal.

There is an iron-brown variety of Opal, that M. Beudant calls *Ferruginous Opal*, which is probably the Dark or Blackish Opal of the lapidaries. Its tint masks the bright refraction for which the Opal is so much esteemed, so that it is extremely rare to meet with a fine stone of this kind; but when such a one is found, its value is very great, according to its rarity.

The *Prime d'Opal* is much less valued, though it is extremely pretty. It is cut into slabs for boxes and similar ornamental purposes. The effect of this stone is much heightened by the artificial blacking of the gangue in which the sparkling specks of opal are imbedded: this is effected, it is said, by simply boiling in oil and then exposing to a moderate heat.

The Opal is cut *en cabochon*, or almond-shaped, very rarely in steps, and never in facets, because a convex surface is best adapted for exhibiting that beautiful play of coloured light for which the Opal is so highly prized.

It is said that such flaws as detract from the value of the stone are dissembled by allowing the stone to lie for some time in oil.

The Opal requires to be looked at near, in order to perceive all its beauty: it does not glisten in the light like the gems properly so called, for which reason it requires to be set with diamonds or sapphires.

The Opal has very rarely been engraved, and it is even doubtful whether there are in existence any real antique engraved Opals. In the National Collection at Paris there is a rather large Opal, on which has been engraved a portrait of Louis XIII., while yet a child. You are not however to conclude, from what I have said, that the ancients were ignorant of the Opal. On the contrary, they knew and highly valued it. The Senator Nonius preferred exile to giving up his beloved Opal to Mark Antony. Pliny says it was yet to be seen in his time, and that, though no larger than a nut, it was valued at 20,000 great *sestertii*, or 2,000,000 francs, according to some; but Jameson says it was estimated at

3,840,000 francs, or £160,000! Nonius retired into Egypt, where it is supposed he had hidden his precious Opal. Since the days of Pliny nothing more has been heard of this celebrated ring, unless it be that a certain Roboly, a French interpreter, pretended to have discovered it among the ruins of Alexandria.

All writers speak with admiration of an Opal, probably unique for size, which is deposited in the Imperial Cabinet of Vienna. It is five inches long and two and a half inches wide, and weighs, according to M. Beudant, seventeen ounces. This magnificent stone, says this author, has been known at Vienna for more than two centuries, but when or how found is unknown; it is irregularly polished, in order not to diminish its bulk. It has several flaws, and is not entirely cleared of its gangue.

It is at Kaschau, in Hungary, that the finest Opals are found. They are abundantly disseminated in a rock, which M. Beudant, who has visited the spot, describes as a *trachitic conglomerate.* They are almost always in very small nuts, large Opals being extremely rare. It is only after working for years that an Opal of the size of a shilling, and of a proportional thickness, is found; hence you will readily believe that such stones are greatly prized, and maintain a very high price in the market. The smallest Opal, if really beautiful, is generally worth £4 or £5; and when the stones are large their price rises out of all proportion. There was one at Kaschau of the size of a half-crown piece, and very fine, for which about £3,300 was asked. It is said to have been purchased, but for what sum is not stated, by

the Baron de Brudern, who, in 1822, farmed the Opal Mines. M. Leyman says that a pair of Harlequin Opals, of four and a half lines, and perfect of their kind, sells for £100, and that a single Oriental flame Opal of five lines is worth the same sum, if without defect. In Turkey, when they are fine, they are equal in price to Diamonds of the same size.

You are probably aware that the armorial bearing of Poland is a White Eagle, single headed, and the national colour a raspberry crimson. Well, the throne-room in the palace, built by Sigismund III. at Warsaw, was hung with velvet of that colour, studded with silver eagles; the eyes of which were small Opals. When I saw this room, many of the Opals still remained, but some had either fallen out or been stolen.

The Opal has ever been known by the same name; but the origin of that name is unknown, unless, indeed, it be derived from a Greek word signifying *vision*. By the ancients this stone was supposed to possess the virtue of strengthening the sight.

Although the Opal is one of the most beautiful of stones, it owes that beauty to its imperfections. Its colours are due to a number of minute fissures, filled with thin films of air, which refract the light into those beautiful colours that constitute all the beauty of the Opal. These fissures render the stone very fragile, and not unfrequently it splits by a sudden change of temperature; to which must be added, that it is not hard, and is therefore easily scratched, by which you will see it is a jewel that requires to be preserved with care.

Hitherto I have spoken to you of the *Noble Opal* only; the other varieties being less beautiful are less esteemed.

Common Opal.—This stone is generally milk-white or greyish, or yellowish-white and greenish-white: the first of these, according to Jameson, passes into bluish; the second into smoke-grey, the third into yellowish-grey, honey-yellow, ochre-yellow, hyacinth-red, and a colour intermediate between flesh-red and brick-red. The greenish-white variety passes into apple-green, pistachio-green, and mountain-green; but the common Opal never has more than one colour in the same stone. The milk-white variety, when turned to the sun's rays, shows a yellow or red light. This is the Girasol, according to Jameson, as I have already observed in speaking of the Quartz Girasol. It is found at Zimapan, in Mexico, and in the Faroe islands; it is also called *Fire-opal.* That from Mexico is of a rich topaz yellow, is transparent, and with an opalescent lustre. Besides these localities, common Opal is found in many other places. The green variety, as also the wax-yellow variety, sometimes called *Wax-opal*, are employed in jewellery. These have been named by some *semi-opals*, and have been confounded with the *pitch-stones*. Indeed, all these stones pass into one another in a way which makes it extremely difficult to determine their limits with precision; and hence the confusion of names.

Jasper Opal seems to be merely a particular modification of the Opal; perhaps a beginning of decomposition which renders it opaque. It is of different colours, and is not unlike jasper, from which, how-

ever, it differs by its perfect conchoidal fracture, by its superior lustre, by its easy frangibility, and its less weight.

Silex Resinite Hydrophane, or simply *Hydrophane.*—This variety, which is naturally opaque, is remarkable for becoming translucent after lying for some time in warm water. The experiment should always be made with very pure water, otherwise a sediment might be deposited in the interstices of the stone, and prevent a repetition of the phenomenon. The names of *Oculus Mundi* (eye of the world), and *Lapis Mutabilis* (changing stone), have been sometimes given to this mineral. Some Hydrophanes become opalescent to a certain degree in becoming translucid; such is the case with those of Hubersberg, which Klaproth has called *Hydrosane*, and of Pecklin, in Upper Hungary, mentioned by De Born. One of them, which is brown, becomes of a garnet-red in the water. I possess one which is also brown, but which, after being immersed in water, assumes the opalescent violet-blue colour of the Iolite. Hydrophanes are also met with in Saxony, in the Faroe islands, at Telki Banya, in Hungary, at Chatelaudren, in France, and Musinet, near Turin, &c.

Pitch-stone.—This stone, as I have already observed, has been often confounded with common Opal; it differs from it by a more extensive colour suite, and in the colours being much less pure than in the common or semi-opal. Its lustre is more resinous than in the opal, its fracture is less perfectly conchoidal, and it is heavier.

This would perhaps be the proper place to speak

to you of *Wood-opal*, but I intend to devote one or two letters exclusively to the subject of agatised wood, fossil impressions, petrifactions, &c. I shall therefore pass on at once to the last of the Silexes of which I mean to speak.

Menilite.—This variety, which has also been called *Pitch-stone* of *Menil-Montant*, and confounded with *Semi-opal*, has by some been named *Liber-opal* or *Liver-opal*. This Silex, which has the fracture of the Resinites, is particularly distinguished from them by its schistose structure, which is rare and remarkable in Silexes properly so called. It is generally of a liver-brown, and is a little translucid. Its form is irregular, rounded, knotty or tubercular. It is found in nodules disposed in interrupted beds in the midst of a slaty clay, interposed between the strata of Gypsum, at Menil-Montant, near Paris. It is also met with, but of a different colour, at St. Ouen, and in the environs of Mans. At this place its fracture is less resinous than the Silexes of Menil-Montant.

Such then, dear Florence, are some of the more remarkable of the Silexes—some of which, you will have observed, are very important from their utility, and others much valued for their great beauty. I have also pointed out to you that there exists much confusion in the names and arrangement of the varieties; and, in fact, Quartz, Silex, Agate, Opal, &c. are all modifications of the same substance, and pass imperceptibly the one into the other, so that they might be arranged either according to the fineness of their texture, their degree of translucidity, or their colour, without its being possible to discern any distinct limit among the varieties thus disposed;

but, fortunately, those which come very near to each other in some one character, are widely separated by others, which enables us to distinguish them sufficiently for our purpose. The most ignorant will never confound a flint with a Rock-crystal, nor an Opal with a Cornelian.

Adieu! Remember that if these letters have little or nothing in them to amuse, they are chiefly destined for your occasional instruction.

LETTER XII.

Jasper—White J.—Red J.—Yellow J.—Green J., or Lancet-stone—Brown J.—Black J.—Ribbon J.—Eyed J.—Egyptian J.—Figured J.—Diaspro Antiquo—Porcelain J.—Jade—Saussurite—Amazon-stone—Chinese Yu.

IF you will call to mind all the pompous descriptions you have ever read of palaces, real or imaginary, you will find that in every one of them Jasper is mentioned as among the materials of their construction, or of their ornaments: and, in truth, the variety of colours exhibited by this stone, the large size of the pieces which may be obtained, the mirror-like polish of which it is susceptible, and the expense of working, are all so many circumstances which combine to render it peculiarly, if not exclusively, appropriate for the decoration of those sumptuous abodes of kings and princes.

JASPER is a stone which approaches very nearly to the nature of Silex, being in many cases equally hard with it. It strikes fire with steel, and its fracture is conchoidal, like that of the Silexes; but it is dull, and this character alone is sufficient to distinguish it. It is perfectly opaque or very slightly translucent at its edges.

Jasper may be divided into the unicoloured and the multicoloured varieties. Of the former, the following seven are the most remarkable.

White Jasper.—This species is very rare; it is of an ivory whiteness, diversified with a few meandering thread-like veins of a crimson-red. M. Brard

is of opinion that this beautiful Jasper is from the Levant. I have seen a variety of it with palmated dendrites of great beauty, and I possess a specimen from India which is reticulated throughout its mass with blue veins and crimson-coloured spots.

Red Jasper.—The colour of this Jasper varies from an exceedingly bright red to a dark or brownish brick-red; when its colour is pure, and without veins, it is much esteemed by the lapidaries. The judgment or execution of Marsyas, and other similar subjects, have been often engraved on Red Jasper. It is found at Giuliano, at San Stephano, and other parts of Sicily, in Piedmont, and the higher Alps, and elsewhere. Sir R. Schomburgk brought some beautiful specimens from British Guayana.

I have a piece of dark Red Jasper with dark metallic veins, which formed part of the exterior mosaic of the Taje Mahal, at Agra, from which it had fallen out.

Yellow Jasper always inclines to the colour of ochre, but it is very rarely met with of uniform colour; being often traversed with white, red, or brown veins. This variety has nothing to recommend it, nor is it esteemed or otherwise used than for the purposes of mosaic. It is met with in Sicily, Dauphiny, &c.

Green Jasper.—It is also rare to find this of a uniform colour; its tint is usually a dark green. It has been called *Lancet-stone*, being probably the same with that I mentioned in a former letter as ranged with Hornstones by some, and used for the sharpening of lancets. It is found in Sicily and at Quel, near Grenoble, and in the East Indies. In

Java a fine variety has been discovered, which passes into Agate.

Blue Jasper.—This colour is never very bright, it always inclines toward greyish or lavender-blue; nor is the colour equally distributed throughout the mass, if this be large. Sicily, Dauphiny, and Siberia, produce Jasper of this colour. In the latter locality it is cut into seals; it is, however, rarely met with in the market, and is little esteemed, though I really cannot see why: its paste is fine, it takes a good polish, and its tint, when uniformly distributed, I think very chaste and pretty.

Brown Jasper.—This is the most abundant of all: its colour varies from a reddish-brown to liver-brown and chocolate-colour. It takes a finer polish than either of the two preceding varieties. This Jasper abounds in Sicily and Siberia, and is much prized.

Black Jasper, or *Paragone* of the Italians.—It is of a pretty deep black, but seldom found in pieces of a certain size without veins or spots. This beautiful variety is also found at Giuliano, in Sicily. Such are the principal Jaspers having but one colour, and they are the only ones which supply slabs of a certain dimension, having a uniform tint—the multi-coloured, or rather, the bi-coloured Jaspers are—

Ribbon Jasper.—In this Jasper, as the name implies, the colours are arranged in bands or stripes, which are generally very well defined; some are pale yellow and bluish-green, some exhibit two distinct reds, disposed in curved delineation like the fibres of wood—others are flesh-coloured with green bands—or brown and white—or yellow and red—yellow and

violet, &c. Many of them are from Siberia, Bohemia, and Saxony, but are produced in many other places. Of these varieties, the most highly prized is that in which a fine, though rather dark, green alternates with a rich reddish-brown or chocolate colour in very regular and distinct and generally straight bands: an arrangement which has induced some to engrave it as a cameo in the manner of the Onyx.

Eyed Jasper.—On a very deep brown ground, and perfectly opaque, are seen a multitude of small round spots, or little eyes, one or two lines in diameter, composed of two or three white concentric circles, very fine, but perfectly marked. There is also another beautiful Sicilian variety in which the ground is yellow, and the round eyes are an olive-green.

Egyptian Jasper, vulgarly *Egyptian Pebbles.*—The colour of this stone is a chamois-yellow, with patches of rich brown of various shades very agreeably distributed and blended.

This is one of the prettiest of the Jaspers, and is much prized by amateurs; for, independent of its beauty, it takes a very brilliant polish. Its markings, moreover, often assume the resemblance of various objects, as is the case of the one I mentioned when speaking of *Gamahées.* The locality of this variety is Egypt, as indicated by its name; it is there found in the sands, as also in those of the neighbouring deserts, particularly that of Suez, and appears to have formed part of a breccia composed of fragments of hard stones, extensive beds of which constitute the greater portion of the soil where these Jaspers

are found scattered in isolated lumps from the decomposition of the breccia.

Yellow Jasper with green Dendrites.—In Sicily there is also found a Jasper of a deep orange-yellow, embellished with lines and herb-like figures of a pretty green. This kind is valued because of its rarity and its being found only in small pieces.

Yellow Jasper with tiger-like black markings.—The ground colour of this variety is an orange-yellow inclining to brown, and this is thickly covered with dendritic patches of a fine black. It is much employed in German jewellery, and is from a quarry near Oberstein.

Brown Jasper with Dendrites of Bismuth.—This Jasper is of a deep, dull, brownish-red; but it is agreeably varied by silver-white dendrites of native Bismuth. It is found at Schneeberg, in Saxony, in the mine of the *Cerf-blanc.*

Flowered Jaspers.—Under this name are distinguished those of two different colours, not banded, and under that of *Variegated* or *Universal Jasper*, those in which a greater number of colours are disposed in spots, patches, or clouds. Some Jaspers present a mixture of Jasper and Agate, and according as the one or the other of these predominate, they are termed *Jasper-Agates* or *Agate-Jaspers.*

Ferber mentions an antique Jasper-Agate of a milky whiteness, marked with brown patches of different sizes, and very irregular, accompanied by lines or veins of the same colour, and perfectly opaque. Very beautiful tables of it are to be seen at the magnificent *Villa de Mandragone.* The quarries from which this beautiful stone was extracted are

no longer known; but the Jasper itself is well known in Italy by the name of *Diaspro Fiorito reticillato Antiquo*. As for the Flowered and Variegated Jaspers, they are so numerous and so various that an attempt to describe them would be fastidious. The author of the "Mineralogy of Sicily" describes one hundred varieties found in Sicily alone.

The Jaspers of several colours are very subject to cracks, or to dull earthy veins and patches very injurious to their beauty, and accordingly these defects are sought to be dissembled by every conceivable artifice, more particularly by filling up such cavities with a mastic coloured in imitation of the stone; but this soon cracks and falls out, leaving the defect even more visible than before.

I have already alluded to the Blood-stone Jasper, in speaking of the Heliotrope, in my ninth letter, and there mentioned a remarkable spotted one.

Some Jaspers are very beautifully decorated with golden sulphuret of iron in feathery designs and spots of great beauty. I possess two or three varieties of this kind.

Jasper is found in thick and continuous beds, and also forming entire hills: it also exists in nodules, dispersed like the Agates in amygdaloides and lavas.

Fossils are occasionally met with in Jasper; thus there is a Jasper at Court, in the department of Haut Rhin, with shells in it, and, in another bed, with marine plants.

All mountain-chains, even those which can only be considered as hills, contain Jasper. The hill on which is built the fortress of Orska, on the left bank of the Jaïk, in the government of Orenbourg, is

wholly composed of a Jasper, of a pale green and deep red; it is disposed in inclined beds.

Jasper is worked into vases, sabre, poignard, and knife-handles, boxes, seals, and other objects of a like kind. It is also employed for the inlaying of altars and panels, for plinths and pedestals, and very extensively for Florentine mosaic. With the flowered Jasper a particular kind of inlaid work is made, called in Italy *Impelliciatura.*

The ancients were acquainted with Jasper and worked it; for several engraved antiques of this kind have come down to us, particularly of Red Jasper. Pliny assures us that it was worn as an amulet throughout the East, and that he saw a slab of fifteen inches long, on which was engraved a portrait of Nero armed with a cuirass. Gallic axes of Jasper have been found; and in the accumulations of the Mediterranean, buried bludgeon-heads, &c. of Jasper are occasionally turned up.

Porcelain Jasper.—Under this name is designated a mineral which is of the nature of Jasper, although its fracture is shining and rather splintery than conchoidal. It is opaque, and in colour varies from pearl-grey to bluish-grey and lavender-blue. It is also found yellow and brick-coloured, of different shades. It takes a fine polish, but is often full of minute holes.

It would appear that this stone is produced by the spontaneous and long-continued combustion of slaty clay in the vicinity of coal-beds on fire: that is to say, it is a species of natural porcelain. This production is not very abundant; it is, however, met with in Bohemia, between the Erzgeberg and the

Mitelgeberg, at Planitz, near Zwickau, in Saxony; also near St. Etienne, where it is in alternate flakes of grey and red. At Schlagenberg, in Bohemia, it is of a Jade-green colour. Several varieties of it are found at Dutweiler, near Sarrbrück, &c. It exists also in England, Scotland, and Ireland. Some varieties are occasionally met with of a grey colour, with vegetable impressions of a brick-red.

Having nothing further to say to you on the subject of the Jaspers, I should here close my letter; but perceiving that I have got some space left, I shall fill it up with a word or two on another mineral, which you have, no doubt, seen cut into vases and other ornamental objects in palaces, or fashioned into axe-heads, &c. in the cabinets of the curious. I allude to *Jade*, a substance placed by some among the Felspars.

JADE, when polished, has a greasy aspect as if it had been rubbed over with oil. It is harder than Quartz, and its tenacity is so great that it cannot be broken without much difficulty. Its colour is generally green, of different shades, for the most part pale or cloudy, and dull. It looks opaque, but is, in fact, translucid; its fracture is dull and waxy, or even scaly; there are different varieties of it.

Nephritic Jade, or *Nephrite Stone*, or simply *Nephrite*, is of a pale green passing into leek-green, and sometimes it has a slight tinge of lilac. This variety is very translucid, equally difficult to break and to polish, and has a more greasy aspect than any of the other varieties.

There are two kinds of Nephritic Jade, which, however, hardly differ but in locality. One is the Indian Jade; it is of an olive-green and gives much

fire with steel, the other is from China ; it is whitish, and does not strike fire. Both bear alike the name of Oriental Jade or Nephrite. Many imaginary virtues have been attributed to it, such as the cure of nephritic colic, the prevention of epileptic fits, and the cure of the bite of venomous insects; and accordingly it was much worn as a charm.

Jade of Saussure, or *Saussurite*.—Although Jameson has placed this mineral by itself as a particular species, it appears to differ but little from the former. It was found by De Saussure, as rounded stones, on the borders of the Lake of Geneva, and in the Mountain of Musinet, near Turin. Prince Galitzin says a variety of this stone is met with in the sand in the environs of Potsdam.

Axe-stone.—This variety of Jade, of a darker and often more unequal colour than the preceding, is sometimes translucid only on its edges; it is more easily broken, and takes a less brilliant polish. This Jade comes from America, whence it was first brought by Captain Cook. Its precise locality is not known, but its occasional slaty texture leads to the presumption that it is found in beds. It occurs in the river of Amazons, whence it has been called *Amazon-stone;* a name that has also been given to other varieties, but which should be exclusively confined to the present. It is met with, as I have said, shaped into axe-heads, &c. M. de Humboldt assures us that it comes from some unknown place in the interior of America. He says, speaking of the Jade-stones, in his *Personal Narrative:* "They have been for ages an article of trade among the natives, both on the North and on the South side of

the Oroonoko. The Carribees, who may be considered the Bucharians of the New World, made them known on the coast of Guayana, and the same stones, like money in circulation, having passed successively from nation to nation, in opposite directions, their quantity is perhaps not augmented, and the spot which produces them is rather unknown than concealed. In the midst of enlightened Europe, on the occasion of a warm contest respecting native bark, a few years ago, the green stones of the Oroonoko were gravely proposed as a powerful febrifuge. After this appeal to the credulity of the Europeans, we cannot be surprised to learn that the Spanish planters share the predilection of the Indians for these amulets, and that they are sold at a very considerable price, (a cylinder two inches long is sold for from twelve to fifteen piastres). The form given to them most frequently is that of the Persepolitan cylinders, longitudinally perforated, and loaded with inscriptions and figures."

In Turkey and in Poland one meets with a great many handles of knives, daggers, swords, &c., made of Jade; and from India are brought all sorts of ornaments and trinkets of the most delicate and beautiful workmanship, which is so much the more remarkable from the great hardness of the stone. It is presumed that it must be much softer when first taken out of the earth.

The finest Jades came from Egypt and Persia, from the mines of Kolyvan in Siberia, from India, and from China.

The Chinese call it *Yu*, and they work it into objects of great beauty. Jameson speaks of a vase

of a greenish-white Yu, which was seen by Mr. Clarke Abel, in China, the workmanship of which was truly admirable. The handle represented a lizard, every part of which was cut with the most minute exactness; similar figures were cut round the border. The portion not occupied by figures was engraved with Chinese characters deeply cut *in intaglio*. This vase was valued on the spot at 120 Spanish dollars. A sceptre of white Jade was sent as a present from the Emperor of China to the Prince Regent of England.

Some of those musical instruments which the Chinese call *kins*, and which are made of sonorous stones, are of Jade. One of them may be seen in the Mineralogical Cabinet of the Mining-school at Paris.

The archers of the East make use of rings of Jade, which they wear on the thumb to protect it from the friction of the cord.

Indian Jade comes from Kashgar and the Himmalayah mountains. This is the *Pietro d' Egitto* of the antiquaries, the *Omphax* of Theophrastus, and the *Yeschm* of the Orientals.

LETTER XIII.

Felspar—Adularia, or Moon-stone—Opaline Felspar, or Labradorite—Green Felspar—Blue Felspar—Avanturine Felspar—Sun-stone—Compact Felspar—Common Felspar—Petuntzé—Kaolin, or Porcelain Clay—Manufacture of Porcelain.

TO-DAY, Florence, we shall climb the mountains (in imagination that is to say, and without fatigue,) in order to examine together one of the most widely-distributed substances in nature, namely, Felspar, the ordinary variety of which forms the great mass of the Granite, Sienitic, Gneissose, and of many Porphyritic rocks. It is also very abundant in other rocks, as the Diorites, &c.

Felspar, which name signifies *Spar of the Rocks*, is found of almost every colour; black, grey, white of every tint, red of different tints, yellow and blue, as well as chatoyant and avanturine. The texture, and consequently the fracture, of Felspar is very lamellar, it strikes fire with steel, but is not so hard as Quartz. It occurs both massive and crystallized. Its crystals have four faces that are naturally polished and brilliant, which causes them to be very easily distinguished in those rocks where they are, so to speak, incrusted.

Adularia, commonly *Moon-stone*, *Fish's Eye*, *Argentine*, *&c.*—This variety is limpid, with white, bluish, or green opalescent reflexions. It is sometimes irised, and, in certain circumstances, assumes by transmitted light a flesh-red colour. This variety of Felspar is found in Granite and in Gneiss, in

Greenland and the United States, in Arabia, in Persia, in Scotland, in Norway, Switzerland, France, &c. The finest Crystals of it come from the mountain of Stella, in the St. Gothard group. There is also found among the rolled stones in the island of Ceylon, a kind which is remarkable for its reflexion of pearly light. This has often been, and is still, confounded with the *Cat's-eye,* which, as I observed to you in my sixth letter, is a Chatoyant Quartz.

Adularia was discovered in the St. Gothard, on a mountain which was believed to be Mount Adula, whence the name of the stone; but Mount Adula is in the country of the Grisons.

This stone is cut *en cabochon*, and is sometimes surrounded with rubies or emeralds, with which it forms an agreeable contrast, and sometimes with diamonds, whose brilliant, varied, and sparkling colours contrast still more powerfully with the silvery light which so softly undulates in the interior of the Adularia.

It would appear that this stone was the Hyaloides of the Greeks, and the Astrios of Pliny, which must not be confounded with the *Asteria* of the same author, which was probably a sapphire.

Moon-stone is rather valued than otherwise when it has a fine translucidity and shews a well-defined bluish internal reflexion on varying the position of the stone. M. Brard says that a Moon-stone of six lines in diameter was sold for 705 francs, nearly £35; a monkey's head of this stone, not mounted, 103 francs, or £5; and another *en cabochon*, of four lines, 203 francs, or about eight guineas.

Opaline Felspar, commonly called *Labrador-*

Stone, from its having been first found in the Island of St. Paul, near the coast of Labrador, between seventy and eighty years ago. Its usual colour is grey, but when held in certain positions, more especially if polished, it shews a variety of the most brilliant colours, not unfrequently several in the same piece, particularly if the slab be large, for the colours are generally arranged in broad patches. The most ordinary, and, we may add, the finest colours are blue and green. Yellow and bronze-red are less common, and a pearly-grey is still more rare. I possess a very curious specimen, in which is seen a coloured hexagon of a red purple surrounded by other parallel hexagons of different colours, forming a border to the inner figure. These hexagons have two opposite long sides, and shew, in fact, the usual crystalline form of the mineral. It is from Finland. Besides Greenland, this stone is also found in Norway and in the environs of St. Petersburgh; in the latter case, among the erratic blocks and boulders used for paving the streets of the capital. It has also been met with in the Hartz Mountains and on the borders of Lake Champlain, in America. This variety takes a fine polish, and its rich colours cause it to be sought after for boxes and similar objects.

It seems that this stone owes its colours to fissures that are parallel to the direction of its plates, in which circumstance it differs from Opal, whose fissures, as we have seen, cross each other in all directions. M. Patrin thinks that this mineral owes its colour to the influence of hydrogen gas, generated in the swampy regions where it has almost always been found.

In the celebrated Cabinet of M. de Dree there were some very fine objects of large size, executed in this variety of Felspar, such as slabs for tables, square vases, candelabra, pedestals, &c. In order that you may have some notion of the value of these objects, I must tell you that the rectangular table of M. de Dree, which was composed of two pieces, and was twenty inches (French) by thirteen, and eight lines thick, was sold for 1800 francs, or £75.

Green Felspar.—There are three sub-varieties of Green Felspar. The first and most esteemed is of a bright and equably-distributed verdigris-green; the second is of a pale-green, with abundant white specks; these two varieties take a fine polish, more especially the first. Green Felspar is found near Ekaterinebourg, in Siberia.

For a long time this stone was confounded under the name of *Amazon-stone* with another green stone, found, as I have before said, in a wrought state, on the banks of the River of Amazons. It is cut into slabs for boxes, &c. Vases are also occasionally made of it. There was a very fine one in the collection of M. de Dree. According to Brard, it is rare in France, and much prized for jewellery. It holds one of the first places among the precious stones, though it must not be confounded with the gems.

Blue Felspar.—This rare variety is of a beautiful soft sky-blue, and is agreeably mixed with white quartz and flakes of silvery talc, which produces a very agreeable effect. It is employed in jewellery, though rarely, because it is difficult to procure; for which reason also, objects executed in Blue Felspar are hardly ever seen, except in the collections of

amateurs. This variety has been found only at Keiglach, in Styria.

Avanturine Felspar.—I have already explained, in my sixth letter, what is understood by Avanturine. Of the Quartz and Felspar Avanturines the latter is by far the most prized. The ground-colour is sometimes green, and then the brilliant specks are silvery. This variety is found in the same localities as the plain Green Felspar already mentioned, and of which it is only a modification. A yellowish-brown or scarlet variety is also found with specks of a golden-yellow. The yellow variety has been called *Sun-stone:* it is a very scarce and exceedingly beautiful stone, and sells at a very high price. It has been found by Romme, in the island Cedlovatoï, near Archangel.

Compact Felspar.—According to Jameson, Compact Felspar is of different colours—white, grey, green, and red of different shades; it is found both amorphous and crystallized, it is the *Petrosilex* and *Pechstein* of the Germans. Its fracture is waxy, and it is translucid. There is a red variety of it not unlike Cornelian, and which takes a fine polish; it occurs in Westmanland, in Sweden; the greenish kinds are from the Vosges and the Alps: it is wrought into slabs and boxes. M. de Dree had a table of scarlet Felspar. This variety forms the basis of several porphyries, and is, according to Jameson, very common in Scotland. Such are the varieties of Felspar used in jewellery and for ornamental purposes. I shall now call your attention to another variety of the same substance, of far higher importance.

Common Felspar is less a homogeneous stone than a species of rock composed of a great quantity of Felspar with a little Quartz. Its usual colour is dirty white; it melts into a white enamel, a property which it owes to the potash it contains. A variety of this Felspar, under the name of *Petuntzé,* is employed in the composition of Porcelain. It is used with other materials as a flux, and alone as a covering or enamel, without which the finest porcelain would remain what is termed *biscuit* and without a polish; very pretty for statuettes and similar objects, but of no use whatever for the table, because in that state it would absorb grease of every kind, and soon be covered with spots which could not be removed.

This Felspar is found in beds in the environs of Limoges, of Alençon, and other places. Its name of Petuntzé is Chinese. But if Felspar be so essential for the enamel of Porcelain, it is no less so for the paste of the Porcelain itself, even where it is naturally deprived of its potash by decomposition. In fact, the *Porcelain Clay*, or *Kaolin,* as it is also called, is nothing more than a decomposed Felspar, absolutely infusible at the heat of our porcelain furnaces.

Kaolin, or *Porcelain Clay,* is generally quite white, or slightly pinkish, or yellowish. It is mostly friable, sometimes almost compact, and in this latter state it preserves its original texture. It is often mixed with Quartz in grains, and contains mica. It is rough to the touch, is found in beds of granite and gneiss, and sometimes piled up at the foot of these rocks.

It is quarried in China and several European countries. One of the most known localities is Aue,

in Saxony, whence it is extracted for the celebrated porcelain-manufactories of Meissen. You may not be sorry, my pretty Cousin, to know how a substance so similar to chalk in appearance, so earthy, so opaque, so rough to the touch, becomes converted into those diaphanous vases, so highly valued for the beauty of their forms, and decorated with paintings as brilliant as they are durable. You may easily imagine that several centuries must have elapsed, and innumerable essays must have been made, before the art could have advanced from the rude produce of the potter's wheel to the beautiful Porcelain of Sevres and of Saxony. I shall not, of course, go into the history of this art, but I will give you, in very few words, some idea of the process by which what is termed hard Porcelain is made.

The *Kaolin*, or *Porcelain Clay*, is first well washed in several waters, so as to separate the quartz and the mica, and any hard lumps it may contain. The pure white earth thus obtained is then mixed with Quartz and Silex and other substances, reduced to powder, in different proportions, according to the quality of the Porcelain required, and the particular process of each manufactory. This mixture is passed through several sieves in succession. It is then formed into a paste with rain water, and this is put away in tubs or otherwise, where it remains for a long time. This paste or dough now undergoes a kind of fermentation, and changes its colour and consistence. It becomes grey, tenacious, and soft. The preparation of the dough is usually the secret of each manufacturer. As for the form to be given to the several objects, this is done by first kneading the

paste well with the hands or feet, so as perfectly to incorporate the different ingredients; it is then put upon a lathe, on which all objects that have a round form are turned. The handles and other similar pieces are made by hand, or pressed or cast into moulds, and stuck on the object with the paste itself. The next operation is the baking, which is effected in a stove of a particular construction, each piece being separately placed in a case called a *gazette* or *saggar:* care must be taken to place the pieces very horizontally, otherwise they may fall out of shape; an accident often seen in inferior articles, particularly in the case of plates, and cups with handles, the latter being often oval instead of round. After this first baking, which lasts from thirty-six to forty-two hours, the several objects are taken out in a state of *biscuit*, like that of the pretty little statuette of Psyche you possess. The glaze is now to be put on; for this different substances are used, but the *Petuntzé* is often the only one. This is reduced to a very fine powder, well sifted and mixed up with a great deal of water. Into this milky mass the objects are plunged for a moment; the biscuit absorbes the water, leaving the powdered Petuntzé equably distributed over the surface in the form of a fine powder. The pieces are now placed in another furnace, when the Petuntzé melts and covers the several pieces with an evenly-spread white enamel. Nothing now remains but the gilding and painting, after which the colours are burnt in.

This is a very imperfect sketch of the whole process, but correct in its main features. Of course, in large manufactories machinery of different kinds

is employed, and there are a great variety of processes, all differing according to the nature of the Porcelain or stone-ware that is wanted, but all depending on much the same general principles. Would you know the subject more in detail, I must refer you to Dr. Ure's *Dictionary of Arts and Manufactures*, and other similar works.

Painting on Porcelain is a charming occupation. I have myself tried it with success, though to be quite *au fait* requires a certain amount of practice, as the colours employed are very different in appearance when first applied to what they afterwards become in the fire.

In order to paint upon Porcelain, one should be in the neighbourhood of a manufactory, otherwise the paintings may get injured in the carriage; besides, the colours may be procured at the manufactory already prepared. This preparation consists in a mixture of glass or frit, of borax, of nitre, &c., fused together; after which the vitreous mass is reduced to a fine powder and mixed up with the colouring matters. In using the colours thus prepared, gum, or oil of lavender is employed. The crimsons are obtained by powder of Cassius, which is a preparation of gold; the violets are also from gold precipitated by means of tin and silver. Certain greens are obtained from copper, but the finest is from oxide of Chrome; the reds are oxides of iron; the blues are procured from cobalt; the yellows from antimony; the browns and blacks from iron and zaffre, the latter a preparation of cobalt.

The art of making Porcelain is very ancient in China and Japan; but its discovery in Europe dates

from the year 1706, when Bötticher, a German, made the first Porcelain vases in Dresden. They were brown and red; white Porcelain was only attempted three years later. The manufactory at Meissen was established in 1710.

Thus have we left the rocks to enter into the potteries. There, in the rocks, Felspar constitutes the greater mass of those granitic aggregations which, under the form of gigantic walls, arrest the clouds in their wandering course, forcing them to return to the earth in renovating showers. Here, in the workshop, it is transformed into elegant vases and utensils for our tables, or for sumptuous ornaments.

Every morning, dear Florence, you are indebted to the three kingdoms of nature; the bean of Arabia, the cane of the Indies, the milk of the herd, and the substance of the hard rock, each contributes to your cup of coffee. Think of this, admire nature and the industry of man. Adieu!

LETTER XIV.

Lazulite, or Lapis-Lazuli—Ultramarine, and its preparation.

YOU will have no reason, my dear Florence, to complain of the length of this letter; urgent business just now claims my whole attention, and leaves me but little leisure for the agreeable occupation of corresponding with my amiable pupil. In order, however, not to allow your ardour to cool, I seize an hour in haste to send you a word upon the rich and beautiful production of nature which you have often admired when visiting the palaces and churches of Italy. I allude to Lazulite.

LAZULITE, or *Lapis Lazuli*, says M. Brongniart, is easily recognized by its fine azure-blue colour. The stone is opaque; its texture compact; and its fracture, for the most part, finely granular, but sometimes slightly lamellar. It is hard enough to scratch glass, but does not readily give fire with steel. It is distinguished from azure-blue copper-ore by its not becoming black in the fire, and by its not communicating a blue colour to ammonia.

Lazulite is found in pieces that are not very large, in primitive mountains, especially in the granites; but generally it is met with dispersed in rolled pieces. It is thus found on the borders of Lake Baïkal, in Siberia. It is also met with in Persia, in Bucharia, Grand Tartary, and China. It is asserted to exist in great abundance in the island of Hainan, in the China Sea, whence it is brought to Canton, to be there employed in the arts. The

finest specimens, however, are from Bucharia. If we except a very rare variety, discovered by Klaproth at Vorau, in Austria, Lazulite has never been found crystallized. Lapis Lazuli is often traversed by white bands and spots, which destroy its beauty when it is employed for small objects, but which vary the surface agreeably when it is used in slabs. Its blue is of different degrees of intensity; the finest should be uniform in colour, and of a fine bright azure inclining to purple. When, as is frequently the case, it is mixed with disseminated pyrites of a fine golden. yellow, the effect is greatly heightened. Lapis Lazuli takes a pretty good polish, which, together with its fine colour, causes it to be much prized, both for objects of jewellery and for ornamental purposes. It is accordingly used for rings, seals, brooches, clasps, ear-drops, necklaces, handles of daggers and sabres, boxes, vases, &c., and for inlaid and mosaic work.

The ancients have engraved a great deal on Lazulite. In the Collection of Paris may be seen a bust of Minerva and a figure of Music. M. Brard mentions a beautiful vase of Lazulite, fifteen inches high and of a single piece. This stone is very extensively employed in Florentine mosaic, and it has been very abundantly used in the same way at that truly splendid Mausoleum, the Taje Mahal, at Agra. In slabs it is used, as you know, for inlaying the panels of sumptuous palaces and the altars and shrines in Catholic countries. In the Marble Palace at St. Petersburg, built by the Empress Catharine for Orloff, Lazulite is employed in the greatest profusion.

The use of this mineral is not, however, limited to the purposes I have enumerated. The most important use for which it is employed is the preparation of that most bright and beautiful pigment known by the name of Ultramarine, as remarkable for its durability as for its brilliancy, and which you employ with so much judgment and taste in your exquisite miniatures.

The preparation of Ultramarine is as follows. The pieces of Lazulite, the most rich in colour, are picked out, they are washed, and then plunged into vinegar, and if the colour does not change, the quality is esteemed to be good. The stones are then again repeatedly heated and plunged each time into vinegar. By this means they are easily reduced to an impalpable powder. This is then well worked up into a paste with resin, white wax, and linseed oil, to which some add Burgundy pitch. The paste is then put into a linen bag and kneaded under water, which at first assumes a greyish colour, resulting from the impurities that are first separated from the mass. This water is thrown away and replaced by fresh, and the kneading re-commenced, when the water becomes of a fine blue. This is poured off and allowed to settle, the precipitate being Ultramarine of the finest quality. The repetition of the process furnishes colour of inferior quality in succession, and finally the residuum, being melted with oil and kneaded in water containing a little soda or potash, yields what is termed *Ultramarine ashes.*

The inalterability of Ultramarine is a most valuable quality; but this very property is injurious to the effect of old paintings, for while the other co-

lours have changed, this, preserving its original brilliancy, all harmony is destroyed, as may be observed in many old paintings and frescoes.

The great price of Ultramarine has naturally caused attempts to be made to supply its place by artificial means, and accordingly a pigment to replace it has been invented by a M. Guimet, which is excellent; but that prepared by M. Persoz, of Strasburgh, is by some esteemed even superior.

In conclusion, I will merely add what is related by M. Brard, which fully proves, if proof were needed, the disadvantage of ignorance and the profit of knowledge.

A vessel having arrived from India discharged her ballast on arriving in London, which, unknown to the parties, was wholly composed of Lazulite. The poor captain was quite ignorant of his wealth. The stone was afterwards sold at a very low price; it was carried to France and Italy, where it was used in the preparation of Ultramarine, the price of which, by this accident, sunk from sixteen guineas an ounce to five pounds.

LETTER XV.

The Garnet—Noble Garnet—Pyrope—Common Garnet—Grossularia—Garnet-dust, or Red Emery—Tourmaline—Beryl Aqua-marine—Emerald—Topaz—Minas Novas—Dysthene, Cyanite, or Sappare.

THUS then, my dear Florence, you are glad to have heard how Ultramarine is prepared. I shall again have occasion, in the course of these letters, to speak of the preparation of pigments, as many of them are obtained from the mineral kingdom. To-day, however, I mean to treat of several stones employed in jewellery, either as ornaments for the person or for the embellishment of those rich cups, ewers, and other similar objects of luxury, the fashion of which came to us from the East, and which, at one time deemed almost essential to the rich, are now even by them prized only as antique articles of virtu.

Of these stones, one of the most beautiful, but of little comparative value in consequence of its abundance, is the

GARNET.—Its usual colour is a very rich and velvety-red, though there are Garnets of other colours, as black, green, yellow, fawn-coloured, &c.

The most esteemed of the Garnets is that which goes by the name of *Noble Garnet;* its colour is a deep crimson-red, inclining to bluish, though it is also of other tints. It is a very beautiful stone: its deep colour renders it necessary to hollow it out beneath, and sometimes to place at the back of it a plate of silver. Mounted in this way, it has some-

times been sold by unscrupulous persons as a ruby. The finest Garnets come to us from Syriam, a sea-port of Pegu. According to M. Brard, a Syriam Garnet of a velvety-violet and without defect, is valued at half the price of a blue Sapphire of the same weight. This author further informs us, that a fine Garnet of this kind, weighing sixty-eight grains, was sold by M. de Dree for 3550 francs, or nearly £150. M. Sage speaks of a small vase made of a Garnet, and which was in size three inches by two inches and three lines, and one inch and ten lines high, that was valued at 12,000 francs, or £500.

The second variety is the *Pyrope Garnet.* Its colour is poppy-red, or deep blood-red, inclining to orange-red: it is a magnificent stone, and when cut *en cabochon*, with one or two rows of small facets as a border, and mounted on a gold foil, it produces a very brilliant effect. This stone, known also by the name of *Hyacinth la belle,* is the carbuncle of the lapidaries.

Noble Garnet has been much used for engraving. In the Museum at Paris, there is a fine head of Louis XIII. cut on Garnet; but one of the finest things of the kind is that executed by the celebrated Cali; it represents the dog Sirius, and belongs to Lord Duncannon.

The third kind is the *Common Garnet.* It is found of different colours, but rarely fine enough to be employed in jewellery. There is, nevertheless, at Topschau, in Hungary, a kind that is of a good emerald-green. The pale dirty green kind, named *Grossularia*, from its resemblance in form, size, and colour, to a gooseberry, comes from Siberia. Yellow

Garnets are found in Corsica, orange-coloured ones at Dissentis, &c. Common Garnet is very abundant; it occurs in every country, and is sold at the rate of from six to twenty shillings a pound.

Garnets are met with of all shades and tints, sometimes crystallized with great regularity, sometimes rounded, and sometimes amorphous; sometimes embedded, and sometimes free in alluvial soils. The crystals are occasionally as big as the fist, and at other times are disseminated throughout their *gangue* in almost imperceptible grains. The red Garnets owe their colour to iron, of which metal some contain so large a quantity as to be attractable by the magnet.

Common coarse Garnets, which are very abundant in the mica-slates, are, when large, used as a flux in the smelting of iron, and the smaller are ground to powder for the cutting and polishing of other stones: the powder is known as *red emery*.

Such then are the Garnets. They share the fate of everything which, gifted with some precious quality, has the misfortune to be common. It would appear that man is condemned to esteem nothing according to its true merit, but to value everything by some conventional standard. Let us pass on to other objects.

Tourmaline.—This stone is a true Proteus among stones: it imitates almost all the gems by the variety of its colours. Thus there are brown, green, blue, yellow, and red Tourmalines; and of these there are a great variety of tints.

Green Tourmaline is also called Emerald of the Brazils.

Berlin-blue Tourmaline is called Brazilian Sapphire.

Indigo-blue Tourmaline is called Indicolite.

Honey-yellow Tourmaline is called Peridot of Ceylon.

Red Tourmaline is called Rubellite, Siberite, Red Schorl, Daourite, &c.

Tourmalines are rarely exempt from a certain dull and brownish shade, injurious to their brilliancy; nevertheless some are found very clear.

The green variety is greatly esteemed in the Brazils, where it is eagerly sought by the Clergy, who wear it as a ring-stone in the way the Bishops in Europe wear the Amethyst.

If, says Brard, we except the crimson variety called Siberite, the Tourmaline is a stone of but little value, in consequence of its want of hardness. The Siberite is not generally transparent; it is an aggregation of diverging needles, translucid and which, upon being polished, becomes very agreeably chatoyant. It is cut *en cabochon* at Moscow, and is extremely rare. Siberia, however, is not the only locality of the red Tourmaline; it comes also from the kingdom of Ava, whence Colonel Simes brought a superb specimen that had been presented to him by the King of that country. It is now in the British Museum, and is estimated at £500. Jameson also mentions a specimen of Red Tourmaline, belonging to Baron Racknitz, at Dresden, an inch in diameter. The Roumiantzoff Museum, at St. Petersburg, contains a still larger specimen; and in Morgenbesser's Cabinet, at Vienna, there is a prism of red Siberian Tourmaline which cost 800 rubles.

Besides the extensive colour-suite of the Tourmaline, this stone, moreover, presents different colours in the same specimen: it has been met with of two or three colours very distinct, as blue and red, blue and green, &c.

Red Tourmalines have been often sold for Oriental Rubies, the yellow for Oriental Topazes, and the blue for Oriental Sapphires, &c. They are, however, easily distinguished, as the Tourmaline, when slightly heated, becomes electric and attracts light bodies; besides which, the specific gravity of the two minerals is very different.

It is principally in Ceylon that the brown and hyacinth-red Tourmalines are found, sometimes mixed with those of some other colour. In the Brazils the green and blue varieties are the more common. In Spain they are chiefly brown; and in other parts of Europe a variety is found of a dark brown approaching to black. In Moravia there is a peach-blossom variety, and at Uton, in Sweden, Tourmaline is found of an Indigo blue. Apple, and grass-green varieties are met with at the St. Gothard. In the United States they are found of various colours. South America and Madagascar likewise furnish Tourmalines.

According to M. Brard, a dark green Tourmaline of six lines by four, was sold for 80 francs; another, of the same dimensions, for only 46 francs; while a third, of a rare hyacinth tint and mounted, was sold for 126 francs, or five guineas. A purple Tourmaline is estimated at the double of this when perfect. Schorl is the only mineral which might be mistaken for Tourmaline; but Schorl is only of one colour, and that is black and opaque.

Before leaving the Tourmaline, I must mention, that of late years it has acquired additional importance from its application in the examination of the structure of minerals by polarized light; for if a plate of brown Tourmaline be cut parallel to the axis, it absorbs one of the polarized pencils of light.

The Mineral I have next to speak about, includes a variety which is by some persons esteemed one of the most beautiful of the gems. But before entering on the subject of the *Emerald,* I must say a word on *Beryls* in general, of which it is only a variety.

The BERYL is almost always found in the form of a six-sided prism, longitudinally striated; it is harder than quartz. It is divided into two sub-varieties, of which the first is the *Aquamarine:* its colours are pale, they are bluish-green, yellowish-green, honey-yellow, and dirty-white: this latter usually opaque. Some are quite colourless and transparent. Sometimes there are several colours in the same specimen, and some are occasionally met with that are irised. The sides of the prisms in some specimens are so deeply striated as to obliterate the edges of the prisms, which then assume a cylindrical form. These prisms are often exceedingly slender and very easily broken; at the place of fracture one side is convex and the other concave. Aquamarine, so called from its usual sea-green colour, owes its tint to iron; it is found in primitive rocks.

The crystals of Aquamarine are occasionally very voluminous. At Vienna there is a group of crystals of Beryl, among which are two that cross each other, that are a foot and a half long and six inches in diameter. It is no uncommon thing to find them

several inches long; but these large crystals are very rarely pure. The finest Beryl I ever saw, and which is, perhaps, the finest known, is in the Cabinet of the Mining Corps at St. Petersburg. It is several inches long and of proportionate diameter, of a very beautiful olive green and without defect: it was found at a place 80 versts from Ekaterinebourg, in the government of Perme, in Siberia, and is of great value.

The Roumiantzoff Museum, in the same capital, contains a crystal of pale-blue Beryl mixed with white, twenty-six inches long and eight inches in diameter; it is translucid on its edges, and has portions of a gangue of grey quartz and felspar adhering to it. It was brought from the Tigerski Mountains, in the Altaï.

Beryls are found in Europe, Asia, and America; the finest are from Siberia and the Brazils.

When pure, the Aquamarine is much employed in jewellery, though infinitely less esteemed than the Emerald. The Turks value it much for dagger-hilts. A large Aquamarine simply rounded did at one time surmount the crown of our sovereigns.

The ancients have engraved on the Beryl. Evodus, a famous engraver in the reign of Titus, has cut upon a green Beryl the portrait of Julia, the daughter of that Emperor; and also that of Marcia, celebrated for her improper amours with her uncle Domitian. It is a remarkable object in every respect, and may be seen in the Collection at Paris. Quintillius, a Roman engraver, has also engraved a Neptune on Beryl.

Emerald.—This is the second sub-variety of the Beryl, and it is unquestionably one of the most beau-

tiful stones presented to us by nature. Its fine velvety green is peculiarly grateful to the sight; and it possesses the rare advantage of being equally agreeable when seen in the day-light or by the light of tapers; and, what is more, when worn as an ornament of dress, it suits equally well with black as with white. This stone owes its fine colour to a 300th of the oxide of chrome.

The finest Emeralds come to us from Peru, and from Tunea, in the ancient jurisdiction of Santa-Fé, between the mountains of New Grenada and Popayan. They are also found in the mountains near Coseïr, in the Red Sea, whence it is probable the ancients obtained them.

It was for a long time thought that our Emerald was not known to the ancients, and that their *Smaragdus* was some other green stone; but there is reason for believing that they knew it perfectly well. Pliny states that when the famous Lucullus landed at Alexandria in Egypt, Ptolemy, wholly engrossed with the desire of attaching him to his interest, could find nothing more precious to offer him than an Emerald set in gold, and on which his portrait was engraven. The ring of Polycrates, engraved by Theodore of Samos, was an Emerald, on which was cut a lyre. Many wrought Emeralds have been found in the ruins of Thebes; and, in 1804, the Pope received as a present, an Emerald bearing the name of Jules II., who died before the discovery of America. The Emerald is, moreover, mentioned as the third stone of the top row on the pectoral of the High-priest.

It appears that Emeralds belong exclusively to

the primitive rocks; for although they have been found in more recent formations, it is probable they were transported thither. Their usual gangue is mica-slate; all that I have ever seen were embedded in masses of scaly mica, and such is the case with those lately found in Russia. The Mineralogical Cabinet of the Crown of Spain contains a large block, in which are forty emeralds in the form of hexagonal prisms, some of them an inch in diameter and an inch and a half long, for the greater part of fine colour, clear, and without defect. The greater number, however, as observed by Townsend, have been artificially incrusted.

Emeralds are easily worked; they are generally cut in what is termed the *table* form, square, with the corners cut off, the underneath part being cut into facets that are parallel with the sides of the square. When the colour is bright they are mounted *à jóur*, otherwise, or when a set of equal appearance is wanted, they are mounted on foil. They are usually set round with diamonds or pearls. In South America they are mounted as bunches of flowers on stalks of gold. The ancients cut Emeralds into concave mirrors, in which case they must have produced much the same effect as those glasses which, by diminishing the size of objects, renders them more distinct. Pliny says that Nero, who probably was short-sighted, though for the misery of the Romans he could see but too well, looked at the combats of the gladiators through an eye-glass of Emerald.

The Emerald is greatly esteemed, but it is rarely without defect. Its value, according to Brard, is

from 50 centimes to 100 francs the karat; but a perfect Emerald of six karats was sold for £1,000.

Superstition for a long time attributed transcendant virtues to the Emerald as well as to some other stones; women wore it, but not on the finger, to facilitate labour. We find in the *Cérémonies Religieuses de tous les Peuples*, that the Peruvians, previous to the government of the Incas, worshipped an Emerald of the size of an ostrich-egg; it was exhibited on great festivals, and the Indians came in multitudes from all parts to see their goddess, and to present emeralds to her: the priests and chiefs gave them to understand that the goddess delighted in being presented with her daughters, (the young emeralds,) and by this means they collected a large quantity. The Spaniards, on the conquest of Peru, found all these daughters of the goddess; but the Indians so effectually secreted the mother that she has not yet been found. Larger Emeralds than this of the Peruvians have, however, been found; as we are told by Dr. Burnes, of the Ameers of Sinde possessing an Emerald cut in the shape of a parroquet as large as life!

Having thus fixed your attention on the beautiful Emerald, so well formed for strengthening the sight, you will be all the better enabled to contemplate the brilliancy of the Topaz.

Topaz.—The prevailing colour of the Topaz is yellow, sometimes pale, as in the Saxon variety, which loses its colour by heat, and which, in that state, has been sold for a diamond; sometimes saffron-yellow, as in that from India; sometimes brownish-yellow, reddish, and even pink. These last three

tints are peculiar to the Topaz of the Brazils. Those from this locality which are not red may be made so by strongly heating them. It is even thought that the pretended *Brazilian Rubies* are nothing more than Topazes which have been thus heated. They are also called *Rubicellas.*

Perfectly colourless Topazes are also found in the Brazils, at Minas Novas, and in Siberia; in which latter place they also occur of a pale blue slightly inclining to green. These latter become electric by heat, while those of Saxony acquire electricity by friction only.

In the Brazils, Topazes have been met with of an amethyst colour; they are very rare and much esteemed. M. Vander Nüll, of Vienna, gave for a single specimen of this rare variety 1500 ducats.

Besides Asia and America, Topazes, as I have already said, are found in Europe, particularly in Bohemia and Saxony, in Scotland, in England, &c. Their general form is that of a prism with a rhomboidal or lozenge-formed base. The faces of the prisms are longitudinally striated. Very large ones are sometimes found. Prisms have been seen of twelve inches long and four or six in diameter. Sir John St. Aubin, in London, possessed a Saxon Topaz as big as the fist, and I have seen a colourless one of the same size in the Roumiantzoff Museum at St. Petersburg. In the county of Aberdeen, in Scotland, a Topaz was found weighing one pound three ounces eight drachms and eight grains and a half, Troy, and it is asserted that still larger ones have been met with: (Query, was it not a *Cairngorm?*)

Rolled Topazes are found in alluvial soils, and

occasionally crystals of this mineral have been seen incrusted in rock-crystal, of which singularity there is a specimen at Paris, in which red Brazilian Topazes are sticking in a piece of rock-crystal.

Of all the Topazes, the most esteemed, after the amethystine-coloured, is the yellow Topaz of the Brazil, of a fine colour, not too dark, and pure. The blue Topaz of the same locality is a very beautiful and rare stone, and consequently dear. The colourless variety, called *Minas Novas*, is also prized; it approaches somewhat in brilliancy to the diamond. The other varieties are less esteemed, particularly the Bohemian, which is of a dirty white.

The ancients greatly prized the Topaz, which was their *Chrysolite*, though it is evident that the same name was also given to some very different stone, for Pliny speaks of a statue of Chrysolite four cubits high, representing Arsinoe, wife of Ptolemy Philadelphus, which was seen at Alexandria; but either this is a mere story, or the stone could not have been our Topaz.

Ovid adorns the Chariot of the Sun with Topazes, erroneously translated rubies by St. Ange.

Cleopatra made Antony a present of a fine Topaz. This stone was the second in the pectoral.

Topazes have been sometimes engraved. There is at Paris a fine head of Bacchus cut on yellow Topaz;—also a white Topaz of the Brazils on which is engraved the portraits of Phillip II. and Don Carlos: it formerly belonged to the Kings of Spain. In the Collection of the Emperor of Russia there are many beautiful Topazes.

A famous stone of the weight of twelve ounces, which was among the treasures of Portugal, and which was long taken for a diamond, was in all probability a white Topaz.

Formerly precious stones were hardly distinguished but by their colour, which has introduced great confusion in their names.

Disthene, Cyanite, or Sappare, is a mineral of a fine sky-blue with something of a violet tinge; it is transparent, and occasionally exhibits a pretty opalescence. M. Haüy says it has sometimes been sold as a true Oriental Sapphire; but the greatly inferior specific gravity of the Cyanite, and particularly the great facility with which its cleavage may be effected by a knife, are sufficiently distinguishing characters. Cut *en cabochon* it has a good effect. It has hitherto been found only in primitive rocks, more especially the talc-schists and mica-slates, where it exists in long flat prismatic forms. It is met with in several places in Europe, as in Scotland, in France, in the St. Gothard; also in both Americas, in the Ural Mountains, and in India.

LETTER XVI.

Corundum—Red Sapphire, or Oriental Ruby—Oriental Sapphire—Blue Diamonds—Oriental Topaz—Oriental Emerald—Oriental Peridot—Oriental Aquamarine—Oriental Amethyst—Girasol Sapphire—Chatoyant Sapphire—Asteria Sapphire—Adamantine Spar—Emery, and Preparation of Emery-powder.

IF my letters interest you in proportion as the objects of which they treat are esteemed, this present one should awaken all your attention, as it is devoted to the gems *par excellence*, that is, to those precious stones to which the epithet *Oriental* has been given as indicative of their superior beauty and value, and the possession of which is so much desired on account of their own intrinsic splendour, and still more, perhaps, as an external indication of wealth. And, indeed, all the charms developed by light in the rainbow, all that the diamond displays of brilliant colours in its sparkling refulgence, nature has lavished on a single mineral, whose several varieties present to us, in the most perfect purity, the three primitive colours with their binary combinations and all their various tints. The mineral to which I allude is *Corundum*, a name derived from *Corind*, *Corindon*, or *Caroum*, by which it is known at Golconda, in China, on the Coromandel coast, and other places in the East; whence that variety to which the name is more particularly applied was first brought to England, by Dr. Lind, in 1782. It is divided into two sub-species, *Sapphire* and *Adamantine Spar*. The first of these, though the name

be in common parlance applied only to a blue variety, includes all colours, in the same way as the name Ruby is used by the Orientals as a generic term for the gems, whatever be their colour. Thus, those which are commonly known as white or colourless Sapphire, Ruby, Sapphire, Girasol, Topaz, Emerald, Peridot, Amethyst, Aquamarine, Asteria, &c., with the prefex *Oriental*, are all one and the same stone, viz., Sapphire, or pure, transparent, coloured Corundum.

Corundum is of all stones the hardest after the diamond, although composed almost exclusively of one of the softest and most unctuous of the earths, Alumina. Its weight is also very great, being about four times as heavy as an equal bulk of water.

It is the great hardness of the sapphires which admits of their taking and keeping so fine a polish, and this property, together with their splendid colour-suite, constitute them the most beautiful productions of the mineral kingdom.

Following the order in which I have named the sub-varieties, I shall first speak of the *Colourless Sapphire*, or *White Sapphire*, as it is also, but improperly, called.—This stone is little inferior in brilliancy to the diamond, for which it has often been sold. These Sapphires are not common in nature; but both blue and yellow Sapphires are deprived of their colour by heat.

Red Sapphire, or *Oriental Ruby*.—This is a splendid stone, of a very beautiful bright red, with a slight tinge of violet, particularly perceptible when held near the eye. Fine Oriental Rubies are scarce, and their price is consequently high. A stone of

this kind, weighing thirty-one karats, if without blemish, and perfect in colour, fetches a higher price than a diamond of the same weight. The best come from the environs of Syriam, in Pegu. This gem is also found, but more rarely, at Ceylon, as also in Bohemia, and near Expailly; but the Red Sapphire of the latter locality is less esteemed than the others.

The most remarkable Oriental Rubies mentioned, are two belonging to the King of Arrakan, each of which is a six-sided prism of the length of the little finger, and of about an inch in diameter at the base; a form which precludes the possibility of confounding them with any other stone.

Tavernier tells us that the throne of the Grand Mogul was adorned with 108 Rubies, of from 100 to 200 karats each. It has been thought that some of these stones must be garnets; but whoever has seen, or knows anything of, Oriental wealth, will be no way surprised at this quantity of fine Rubies, though some of them may have been Spinels, and not Red Sapphires.

The same author assures us that the King of Pegu monopolizes all the finest Rubies of his dominions, not suffering any of them to be exported by his subjects. Whence it follows, either that those which we have in Europe cannot be from that country, or that they have been clandestinely exported thence.

The celebrated Marco Paolo says, "The King of Ceylon is reported to possess the largest Ruby that was ever seen, being a span in length, and of the thickness of a man's arm; brilliant beyond description, and without a single flaw. It has the appear-

ance of a glowing fire, and, upon the whole, is so valuable that no estimate can be made of its worth in money. The Grand Khan Kublaï sent ambassadors to this monarch, with a request that he would yield to him the possession of this Ruby, in return for which he would receive the value of a city. The answer he made was to this effect, that he could not sell it for all the treasure of the universe; nor could he, on any terms, suffer it to go out of his dominions, it being a jewel handed down to him by his predecessors on the throne." Marsden, in a note, doubts the existence of this jewel, or regards it as a coloured crystal. He was, perhaps, not aware that a natural crystal of this colour and size would be just as rare an object as the Ruby.

The ancients did not engrave on the Ruby. The portrait of Henry IV. engraved upon that stone is a modern work, having been executed by Coldoré.

The Ruby was one of the stones of the Pectoral.

The Oriental Sapphire, properly so called, is of a beautiful velvety-blue, and certainly, for those who admire this colour, it is one of the finest stones imaginable. It was consecrated to Jupiter by the Greeks, and their high-priest wore no other. It was also the sixth stone in the breast-plate of Aaron. The insignia of the S. Esprit, worn by the kings of France, and which is a dove, is formed of a single Sapphire of great size; it is mounted on a ground of white brilliants, and surrounded by diamonds of four grains each, of a blue colour, almost as intense as that of the Sapphire. It is the finest suite of *blue diamonds* in the world. It is said that the Museum of Paris formerly contained an Oriental Sapphire weighing

166 karats, and valued at 1,200,000 francs, or £50,000.

When the colour of a Sapphire is pale, foreign lapidaries call it a *female* Sapphire; but when of a *deep* indigo blue, it is called a *male* Sapphire. Were I disposed to gallantry, I would say they are right, that everything soft and celestial is an image of your sex, whereas masculine virtues have ever a character of depth and concentration.

Ceylon produces more blue Sapphires than red; in Pegu it is just the reverse.

The Oriental Topaz, or *Yellow Sapphire,* is of a pure yellow, intermediate between the russet-yellow of the Brazilian and the pale yellow of the Saxon Topaz, nevertheless other tints are occasionally met with. The light and dark ones come from Ceylon, those of jonquil and nankeen-yellow are rare.

The Oriental Emerald, or *Green Sapphire,* is particularly esteemed on account of its great rarity; its colour is not deep, that is to say, it is much less so than that of the Beryl Emerald.

The Oriental Peridot, Aquamarine, and Amethyst, resemble in colour the other stones of the same name; but differ from them essentially in composition, weight, hardness, and brilliancy.

Certain Sapphires present a particular play of light; such is the case with the *Girasol Sapphire,* in which the opalescence is pinkish, aurora-coloured, or bluish. The *Chatoyant Sapphire* shews bright pearly reflexions on a ground colour of red or blue. Finally, the most curious are those which, when the stone is red, display a bright gold-coloured star of six rays, and when blue, a similar star of silvery brightness.

These two are the true *Asteria Sapphire*, the latter of which is from Ceylon. This curious phenomenon, which renders them so remarkable, is due to the internal structure of the crystal, and is rendered evident by the way in which it is cut.

But, as if nature had not done enough in lavishing such beautiful colours among the different sub-varieties of the Sapphire, she has more particularly favoured some specimens with two, and even three, colours.

The Sapphires are always found in alluvial soils, particularly in the beds of torrents and rivers in the vicinity of primitive mountains, where they occur in the form of little rolled pebbles or crystals with their angles worn down. Sapphire becomes electrical by friction, and keeps its electricity for several hours.

These, then, dear Florence, are the *gems* properly so called, for although many other stones are classed among the precious stones, the Sapphires, together with the diamond, the fine opals, and a few of the most perfect and beautiful of the precious stones, are the only ones entitled to be called gems. They are the rarest, the most beautiful, and most perfect in all respects, and consequently the most highly valued.

Adamantine Spar.—The locality of this variety of Corundum is much better known than that of the Sapphire. It is found in granitic rocks, into the composition of which it enters in the manner of felspar. Its hardness, though extremely great, is yet inferior to that of the diamond, whence it derives its name of Adamantine. Its use in the lapidary's art is very important. Reduced to a fine powder, it is

employed in the East for cutting and polishing the gems; but in Europe, diamond powder is preferred to it, particularly for the cutting and polishing of diamonds and sapphires, which are too hard for Adamantine Spar to bring out all the lustre of which these gems are susceptible. The colours of Adamantine Spar are various, but for the most part dull; it is, in fact, a very coarse kind of sapphire.

Besides these two sub-varieties of Corundum, there is yet another substance which is of the same nature as, and by many classed with, Corundum, as a third sub-variety, and that is *Emery*. If you have ever seen this stone, either in the lump or in powder, you may perhaps exclaim, How is it possible that two substances so very dissimilar in appearance, as the Sapphire and Emery, can have any thing in common; the one constituting the gems *par excellence*, exhibiting the brightest and most beautiful colours, the most perfect transparency, and susceptible of the highest polish; the other, a dull, opaque, massive stone, without a single agreeable quality to recommend it? Nevertheless, dear Cousin, Emery is very precious in the arts; and although when polished itself it exhibits no beauty, it greatly contributes to heighten the beauty of many stones by polishing them. To it also is due, in great measure, the brilliancy of metals and the even surface of our mirrors. This last consideration will, I doubt not, raise it somewhat in your estimation; for without the most perfect evenness in the surface of this essential to the toilette, how could a young beauty contemplate those charms with which nature has gifted her for making and keeping her conquests? Who, when envious rivals

would criticise her face, her shape, her dress, could re-assure the anxious fair one of the truth, if not her faithful mirror? Is it not, indeed, your glass which instructs you how to heighten the brilliancy of your beauty by all the graces and elegancies of art? Does it not warn you to remain invisible to company when, after a night passed in unquiet dreams, or in the alarms of an agitated imagination, your red eye and pallid cheek might divulge to the lover or the rival what you would fain hide from both? And, again, is it not this same friend, incapable of flattery, that informs you gently, and by degrees, of that cruel change which time effects, and preaches thus a moral lesson? Yes, certainly, your sex owes much to the mirror, and we, also, indirectly.

Well then, the looking-glass is indebted for a great part of its perfection to Emery, which is employed for wearing down its asperities and polishing its surface. This particular service, however, rendered by this stone, would not of itself have justified my mentioning it in connexion with the Sapphires, were it not that it is, in fact, the same substance in a coarse state. Emery is to the Sapphire what common coarse lime-stone is to Iceland Spar.

You will easily imagine that Emery owes all its value to its hardness. Its specific gravity is the same with that of Corundum in general; and before it can be employed it must be reduced to a very fine powder. You may like to know the process by which Emery-powder is prepared; it is both simple and ingenious.

The larger blocks of Emery are broken down under stampers of cast iron, and this coarse powder

is afterwards ground finer in mills of steel. It is then thrown into a vessel with water and violently stirred up, after which it is left for half an hour, and then the water poured off into another vessel, in which it deposits the fine powder it held in suspension; this is called Emery-powder of thirty minutes; it is that which is used for polishing precious stones. Having thus obtained all the powder susceptible of remaining suspended for thirty minutes, the operation is repeated by putting fresh water to what remained in the first vessel, and again stirring; after which it is allowed to remain quiet for fifteen minutes only, and is then poured off and allowed to deposit. This second operation gives a coarser powder. In a word, these operations are repeated till at last only thirty seconds are allowed before pouring off. The last powder thus obtained is the coarsest, and is used for cutting hard bodies.

The geognostic locality of Emery is known only in the case of that of Saxony, where it occurs in beds of steatite in a schistose rock. That which comes to us from the East Indies, Smyrna, and Jersey, is found in scattered masses. I have myself found Emery of a very superior quality among the boulders scattered over the soil in Eastern Prussia. Its colour is usually brown, and its general appearance is very similar to an ore of iron.

In my next I shall conclude the subject of the harder stones, and then speak to you of other mineral substances, less beautiful than those which have hitherto occupied our attention, but of much greater utility.

LETTER XVII.

Emery—Chrysoberyl, or Cymophane—Spinel Ruby—Ballas Ruby—Alabandine Ruby—Rubicella—Peridot—Diallage and Hypersthene—Verde di Corsica—Chatoyant Diallage—Bronzite—Hornblende—Asbestus—Amianthus.

I REGRET, dear Florence, to find you labouring under an impression that I suspect you of paying a coquettish adoration to your looking-glass, and am most happy to hear that you are troubled neither with unquiet dreams nor an agitated imagination. My remarks were only intended as a little innocent raillery, though I have no doubt they may be literally applied to too many. Should you, however, be disposed to quarrel with Emery for contributing to aid the vanity of the sex, you will perhaps be reconciled to it, when you know that it also contributes to their industry and favours their efforts in the cause of charity. Not to speak of delicate embroidery, which a puritanic lady, or one belonging to the Society of Friends, might object to as "trappings of the gay world," I will merely observe, that the linen you make up for the children of the poor, and the warm hose which Aunt C—— is so unceasingly knitting for the winter-wear of the destitute, could neither of them be so well executed, nor with so much ease, but for the polish given to sewing- and knitting-needles by Emery-powder. Leaving you, therefore, to balance the account between these several doings of Emery, I shall at once proceed with our proper subject.

Chrysoberyl is a stone almost as hard as the Sapphire, and which, when pure, is a very pretty stone, particularly if it possess the opalescence which so greatly enhances its value, and on which account it has obtained the name of *Cymophane*, which signifies a floating light. It is also called by lapidaries the Oriental, or Opalescent, or Chatoyant, Chrysolite. Its colour is green inclining to yellow. Brard says that a Chrysoberyl of a dark green with a white opalescence, four lines and a quarter by three lines and a quarter, was sold for 603 francs, or £25, and Jameson seems to esteem it highly. It is usually found in the form of little rounded or rolled masses at Novas Minas, in Brazil. It is also said to have been found in the environs of New York. It occurs generally in alluvial soils along with topazes, and in a sandy rock, together with diamonds. At Haddam, on the Connecticut river, in the United States, it occurs in a granite, accompanied by garnets, beryls, and tourmalines. At Ceylon it is found in the beds of rivers with sapphires and tourmalines. It occurs also in Pegu, at Nertchinsk in Siberia, &c. It becomes electric by friction, but is not affected by heat.

Spinel.—This is the Ruby, properly so called, which must be distinguished from the Oriental Ruby or Red Sapphire I spoke of in my last letter, as well as from other stones with which it has been confounded, and of which I will speak to you hereafter.

The *Spinel Ruby* presents several colours, and it has accordingly different names; thus the scarlet Ruby is pre-eminently the *Spinel Ruby*. The rose-

red is the *Ballas Ruby,* of Balachan, in Asia; the violet-coloured is the *Almandine*, or rather *Alabandine Ruby*, (from Alabandin, a town of Caria, in Asia-Minor, where it has been found,) the orange-red is the *Rubicella.* There are also blackish, blue, white, (that is, colourless,) and green Rubies; the two former not common, the last extremely rare.

Spinel is harder than topaz, but less hard than Sapphire, and although it be much less prized than the Oriental Ruby, it is nevertheless a much valued stone when of a certain size. Its crystals are generally small and their form an octahedron, that is, two square pyramids base to base. But when a Spinel is of fine colour and weighs about four karats, or sixteen grains, it is valued at half the price of a diamond of the same weight. Brard speaks of a Spinel of 215 grains which was destined for the Empress Josephine.

The dragon which is, or was, in the insignia of the Golden Fleece, worn by the kings of France, was of a single Ruby of extraordinary size; but in the treasury of St. Denis, in France, there existed a still larger one, which unfortunately was spoiled by St. Louis, who had it bored in order to enshrine in it a pretended thorn of the crown of Christ.

Sir R. Ker Porter, describing the costume of the Schah of Persia, says, that the lower point of his shield was formed of a single Ruby, which for its size, the brilliancy of its colour and its perfection, was unique in the world.

The *Ballas Rubies* used to come from Balachan, a province of Usbec Tartary, where they occurred of a fine quality and of great value. In the time of

Marco Paolo, the Rubies of Balachan were a monopoly of the sovereign, who, in order to keep up the price, prohibited the working of the mines. Elphinstone, in our own times, says the Ruby-mountains near the Oxus are not now worked. It is, however, pretended by some, that Balachan is only the Indian name of Pegu, where, it is known, Spinels are also found. This pretty stone is likewise found in Mysore and in Ceylon, where it occurs in the sand of the rivers, and in a rock of gneiss. The North has likewise its Rubies, as they are met with at Acker, in Sundermannland.—Leaving now the Ruby, I will say a word on the

PERIDOT.—This stone is but little esteemed, though it is met with in the trade. Its usual colour is pistachio-green, but it is also of other shades of green. It has been divided into two sub-varieties, the Chrysolite or prismatic Peridot, or simply Peridot; and the *Peridot Olivine*, or simply *Olivine*. The former is by some considered the same with the Chrysolite I have already mentioned under that name; they are, however, different. The Peridot soon loses its polish, on account of its want of hardness; indeed, it will barely scratch glass. This want of hardness is so much the more to be regretted as the colour is sometimes agreeable, and very large pieces are found. Thus Dr. Clarke states, that the lady of the Russian Ambassador at Constantinople, bought in that city a piece of the size of a turkey's egg, which she had cut into bracelets and other ornaments. This stone owes its colour to iron, and accordingly loses it in nitric acid. It is cut step-fashion, like most of the coloured stones, and is

mounted on a gold foil. It comes to us from the Levant, and is also found, we are told, in Upper Egypt and on the borders of the Red Sea, as also in Bohemia, and at the island of Bourbon. M. Leyman says that a Peridot of eleven lines sells at Paris for 100 or 120 francs, £5 or £6.

The second sub-variety of the Peridot, the *Olivine,* also called *Chrysolite of the Volcanoes*, is generally of an olive-green, whence its name; it is found massive, and in rounded grains, from the size of a hemp-seed to that of the head. Faujas de St. Fond says, that at Colombier, in Vivarais, pieces are found weighing thirty pounds; M. Brongniart, probably by mistake, says from thirty to forty killograms, which would be from sixty to eighty pounds. Olivine is rarely crystallized. In hardness, it is even inferior to the former variety, and is never employed. It is found in almost all volcanic regions, or, perhaps it would be more correct to say, it is only found in Basalt, and in such rocks as are supposed to be of volcanic origin. It is thus that it occurs in Scotland and Ireland; and, on the Continent of Europe, in Bohemia, Saxony, Styria, Austria Proper, Hungary, France, Italy, Spain, &c.; in Africa, at Teneriffe, St. Helena, and the Isle of Bourbon; in North America, in Greenland, and in the Cordillera of South America.

Diallage and Hypersthene.—Diallage has a general external resemblance to Felspar, of which substance I have spoken to you in a former letter, but it is less hard, being easily scratched with a knife, and itself hardly scratching glass. There are three varieties of Diallage, which, by some miner-

alogists are separated under particular names: these varieties are the *Green,* also called *Smaragdite*, the *Chatoyant*, and the *Metalloid;* the two latter being also called *Schiller Spar* and *Bronzite*.

The first of these is of a bright green, sometimes with a pearly or silky lustre, but always opaque, except on the edges. It is found near Turin, at the foot of Mount Mesinet on the side towards Genoa, at Monte Rosa in Switzerland, and on the borders of the Lake of Geneva, in boulders of Saussurite. In Corsica it forms a constituent part of a Felspar rock, and presents, when this rock is cut and polished, spots of a fine silky-green. The rock itself is known by the name of *Gabbro*, and by that of *Verde di Corsica Duro.* It is of great beauty, and much prized. It is made into boxes and similar objects. There are fine slabs of it in the Chapel of St. Lawrence at Florence. Green Diallage is likewise found in India and Labrador.

The *Chatoyant Diallage* has a bright and peculiar metallic lustre, which appears or vanishes, according to the position in which it is held; the colours it exhibits are a metallic or silky-grey, or a dark bottle-green. This variety, according to M. Brongniart, is almost always found in a gangue of brown and green serpentine. This author adds, that its locality is so much the more unknown, as it is often confounded with the following variety. Jameson, however, says it occurs also in Greenstone, and mentions several places in Scotland where it exists.

Metallic, or *Metalloid Diallage*, or *Bronzite*, shews a more or less golden- or brass-yellow lustre, from which it passes into the redder tint of bronze, whence

its name. It is, notwithstanding, less brilliant than the last-named variety, nor does its bright aspect vanish suddenly. It is usually disseminated in little parallelopipedic masses in a serpentine rock. This variety has been found in France, at the Col de Servière, in the Quayras, department of the Higher Alps, at Matrey in the Tyrol, at Baste near Hartzberg in the Duchy of Wolfenbuttel, in Upper Hungary, in Franconia, in the Isle of Skye, &c.

The different varieties of Diallage are cut *en cabochon*, and when the pieces are well chosen, they produce a good effect.

M. Brard, from whose interesting work I glean so freely, says there exists in the metropolitan church of New Orleans a tabernacle of *Euphotide Bronzé*, that is, of a felspathic rock, containing Bronzite of a light bell-metal colour.

Hypersthene has considerable resemblance in its aspect to the last-mentioned varieties of Diallage. Seen in one direction, it is of a copper-colour and brilliancy ; in another, it is of a dark opaque brown. The Labrador coast is its principal locality, though Jameson says it has been found also in Greenland, in the Isle of Skye, and near Portsoy. In Labrador it is accompanied by Opaline felspar. Cut and polished, this stone presents a fine cherry-red, with a pearly lustre, and it is accordingly employed for rings, brooches, &c. A stone of this kind, cut *en cabochon*, of one inch by half an inch, was sold for £6.

Following a natural order, I shall now speak of a mineral, respecting which there existed for a long time very great confusion; it is the *Hornblende*, under which name have been ranged the *Tourmalines*, of

which I have spoken to you, and the *Schorls*, names that were often synonymous, and also a variety of minerals bearing different names, but whose chemical composition assimilates them to one and the same substance.

HORNBLENDE is generally some tint of green, from which it passes into black. It forms the mass of the Basaltic rocks, the Green-stones, &c. It yields pretty easily to the knife; it is opaque, or presents on the thin edges a fine red colour by strong transmitted light. The crystallized variety, when broken, shews brilliant surfaces.

The most interesting variety is that which is crystallized in prisms, and is of a fine velvet-black; it is commonly called *black Schorl*, a name, say some, signifying valueless, because, being found in the tin-mines of Saxony, it was discovered that, notwithstanding its external resemblance to the tin-ore, it contained none of that metal, and was, accordingly, thrown away as rubbish: but others say the name comes from *Schorlan*, a village of Saxony. Schorl is susceptible of a pretty good polish, and might be made into ornaments for mourning.

ASBESTUS.—I now come to the last of the substances of the class of hard stones of which I intended to treat. You have no doubt been accustomed to regard Asbestus as a very soft stone, but the particular modification of a variety of a stone is no reason, scientifically, for placing it out of the class to which, from its nature, it belongs.

Every one, indeed, has heard of *Amianthus*, which is a variety of Asbestus, whose prisms are mere filaments of extreme fineness, and of such great flex-

ibility, that by the aid of a little flax it may be carded, spun, and wove into a cloth. This property, so remarkable in a stone, was known to the ancients as well as the incombustibility of the mineral, and accordingly, as you must have read, they used it for wrapping the bodies of persons of distinction previous to burning, in order to preserve their ashes distinct from those of the fuel employed.

The surprise occasioned by throwing a soiled cloth into the fire, and seeing it taken out thence perfectly white and uninjured, though it had been made red hot, will be dissipated when we reflect that there is nothing wonderful in the fact of an incombustible mineral remaining unconsumed in an ordinary fire. It is its appearance as a piece of linen which produces the astonishment.

It is said that Charlemagne had a table-cloth of Amianthus which he took pleasure in throwing into the fire after dinner, for the amusement of his guests.

The name *Amianthus*, derived from the Greek, means, what does not soil, in allusion to its unalterability in the fire.

The remarkable property of Amianthus has given rise to many fables. Thus Pliny gravely tells us that this substance is obtained from an Indian plant which grows in an arid spot never refreshed by rain or dew; and that this is the reason why it resists the most ardent fire. We must, however, modify this last assertion of the Roman naturalist, for when Amianthus is subjected to the flame of the blow-pipe or the rays of the sun concentrated in a burning-glass, it melts into a greenish glass: the flame of a candle is sometimes sufficient to melt its finer filaments.

But the strangest idea, perhaps, which has been broached on this subject of Amianthus, is that related by Maro Paolo. This celebrated traveller, though little given to joking, does, nevertheless, sometimes smile. Speaking of the mountains of Tartary, he says, "there is found there a substance of the nature of the Salamander, and which being woven is incombustible." The Latin translation says boldly, that the combustible cloth is woven from the Salamander itself! There is no doubt that the Chinese believed in the existence of the Salamander, for d'Herbelot, in his *Dictionnaire Orientale*, says, "we owe the following remark to Claude Verdilon. It cannot be doubted that the cloth which may be thrown into the fire (without injury) is that which the Greeks call *Asbestin*. We are not agreed as to the matter of which the cloth is made, nor do the Chinese themselves know it any better than we do. Some even say it is wove of the hair of certain rats that live in the flames of certain volcanoes."

In the present day we know perfectly well what Amianthus is. It is a mineral pretty abundant in many countries. Thus it exists in Scotland, sometimes in serpentine rock, sometimes in primitive green-stone. It is also found in England, in the Hartz, in Bohemia, in Saxony, in Silicia, in Switzerland, and in Corsica; at which latter place the celebrated Dolomieu used it as tow for packing up his minerals. It abounds in the Ural Mountains and the Altaï, and is met with in many parts of the United States of America. It forms veins in which the filaments or fibres are perpendicular to the surfaces of the vein, and of various lengths according to the

thickness of the veins, which is sometimes, though rarely, a foot.

In the present day, different objects are made of Amianthus, but these have nothing to recommend them beyond the fact of their *quasi* incombustibility, which constitutes them objects of curiosity. There was a lady at Como who manufactured cloth of different degrees of fineness, and even lace, of Amianthus. The lady of the Viceroy of Italy, in Napoleon's time, possessed a veil of Amianthus. In Siberia, also, purses, caps, gloves, and similar articles, are some knitted, others woven, of Amianthus. In the Pyrenees, girdles are made of the same substance intermingled with silver thread. These girdles are much esteemed by the women, not only on account of their beauty, but for certain mysterious properties they are believed to possess. Amianthus has also been employed as incombustible wicks; and it has been suggested that the perpetual lamps of the ancients were formed of this substance, and constantly supplied by a spontaneous oozing of petroleum. It is also asserted that the Greenlanders use wicks of Amianthus. Attempts have been made to manufacture incombustible paper of this mineral; and M. Demidoff, a Russian proprietor of great wealth, even offered to supply all the government offices of the empire with this kind of paper; but up to the present time the attempt has not succeeded.

Of all the uses, however, to which this curious mineral has been applied, the most useful, perhaps, is in the manufacture of porcelain and other pottery; for by an admixture of it in the paste or dough, this is rendered more binding and tenacious, consequently

less subject to be broken, or to fly by sudden change of temperature.

Finally, the doctors of former times administered Amianthus in different maladies.

Amianthus, I have said, is a variety of Asbestus, which mineral passes imperceptibly from the silky flexibility of the Amianthus, to a degree of hardness which admits of its receiving a good polish. In the kind, called *mountain-cork*, the fibres, instead of being parallel, are entangled together like felt, leaving, however, numerous cavities, which give the mass a degree of buoyancy that enables it to float upon water. This variety, according to its appearance, receives other names, as *mountain-leather*, *fossil-paper*, &c.; as the Amianthus itself is sometimes called *fossil-flax* and *fossil-wool*.

The common, or hard Asbestus, still retains the fibrous texture, but the fibres are coarser, and, at the same time, less distinct. The pieces are also more voluminous, and the colour a dark leek-green. This variety takes a greasy polish. There is one variety which, though very hard, is, at the same time, very silky in appearance, and which, when cut *en cabochon*, offers the same play of light as the *Cat's-eye*. There is yet another kind, which resembles wood both in colour and general appearance; it is called *mountain-wood*, which must not be confounded with *fossil-wood*, which is really wood that has undergone a change. This *mountain-wood* is found in the Tyrol, at Schneeberg near Sterzingen. I should have said that *mountain-cork* and *mountain-leather* are both of them nearly of the colour of common tanned leather.

All the varieties of Asbestus have nearly the same geognostic relation; their gangue is usually a serpentine rock.

Having thus, my dear Florence, concluded all I had to say on the subject of the harder stones, I shall in my next call your attention to the unctuous or soft minerals, after which I shall treat of substances very different, and which, if they have not beauty to recommend them, possess what is infinitely better, eminent useful properties.

LETTER XVIII.

Serpentine — Potstone — Common Serpentine — Steatite, or French Chalk—Agalmatholite, or Figure-stone—Macle, or Chiastolite—Talc—Mica—Lepedolite—Meerchaum.

YOU have no doubt observed, my dear Florence, that from the poverty of language we are far from having a specific name for every individual object. This poverty, however, is not without its advantages; for by forcing us to apply the same name to different objects, the number of words is greatly diminished, to the corresponding relief of the memory, while, at the same time, ambiguity is avoided by the general sense of the sentence in which the words occur. It has also its advantage in a poetical point of view, as it is the basis of those tropes and figures which enrich style, give strength and energy to language, colour objects, and assist the imagination. It is not my intention, however, to enter upon a course of Rhetoric. I would merely observe that even Mineralogy is, in many cases, obliged to borrow from the vocabularies of other sciences, and name some of its objects after others, very different in reality, but with which they bear some real or fancied similitude; this is the case with the substance of which I am about to speak.

SERPENTINE.—This mineral has been so named from the resemblance which the spots and stripes it sometimes exhibits bear to the chequered skin of the serpent. It is a soft stone which feels unctuous or soapy to the touch; it is easily scratched with a

steel point, its powder feels greasy, and does not form a paste with water like clay.

Serpentine may be divided into three varieties, the Noble, Potstone, and Common Serpentine. Its colour is green, of different shades, generally dull; there are, however, varieties that are yellow, reddish, peach-blossom colour, and scarlet: the last two are rare.

Noble Serpentine is of a uniform leek-green, occasionally varied with spots of dark red, due to imbedded garnets. This variety is hard enough to receive a good polish, and as it is very translucid, as well as the garnets it contains, it presents, when worked, a very agreeable appearance, and accordingly it is fashioned up into vases, boxes, &c. which are much prized. This variety comes from Bareuth. The ancients attributed to it imaginary medicinal virtues.

Potstone, by the French called *Pierre-Ollaire*, is generally of a greyish-green, sometimes leek-green, and blackish-green. It is infusible, which together with the facility of working it when newly quarried, and its subsequent hardness, renders it peculiarly fit for many objects that are to be subjected to the fire. Thus it is made into pots and other household utensils, so much the more valued as they communicate no bad taste nor quality to the food. This stone and the application of it to the purposes just mentioned, were known to the ancients, as both Theophrastus and Pliny speak of it: the latter even describes the manner in which vessels were made of it, and the change they undergo from long use. It was called *Lapis-Siphnius*, or stone of Siphnos (the present island of

Siphanto, one of the Cyclades), whence it was procured. In Upper Egypt, where it is still employed for culinary purposes, it is called *Baram-stone.*

There are on the Lake of Como, quarries of Potstone which were worked from the commencement of the Christian Era down to the 25th August, 1618, when they fell in, and caused the destruction of the neighbouring town of Pleurs. It was there wrought into culinary vessels and slabs for ovens, which were almost indestructible; in proof of which it is asserted that an oven in the Valais, has remained uninjured during many centuries. The town of Pleurs derived from its quarries an annual income of 60,000 ducats. In Greenland and in Hudson's Bay, vessels and lamps are made of it, and in Norway and Sweden it is employed for lining stoves, ovens, and furnaces.

Potstone is also extracted in the Valais, where it is known by the name of *Giltstein.* The pots made of it, particularly at Val Sesia, near the village of Allagne, not far from Mount Rosa, and known in Northern Italy and the Grisons by the name of *Lavezzi*, are sold in sets of seven, which fit into one another: the largest, or outside one, is thirteen inches in diameter and seven inches high. They are bound with iron or copper to strengthen them, and for the purpose of fixing on handles. In 1789 the price of a set of this kind was twenty-four francs, or £1. M. Brard, from whom this account is taken, has given a plate of these vessels.

Potstone is sufficiently soft, when first quarried, to allow of its being turned. It is unaffected by changes of heat and cold, and when the pots made

of it become impregnated with grease, which might communicate a bad taste to the food prepared in them, they are heated red-hot, and thus become as clean as if just made. I have said that in Sweden Potstone is used for stoves. Should you again visit Italy, and pass by the Great St. Bernard, if the cold of that frigid region should induce you to warm yourself in the refectory of the hospitable monks of the Convent, you will there see a stove of Potstone.

Common Serpentine holds the middle rank between the Noble Serpentine and Potstone. Its colours vary from grey to yellow and green of different tints and intensity. Ink-stands, paper-weights, vases, lamps, and small knick-knacks, are made of it.

Connected with the same family of unctuous or soft stones is Steatite, or *Soap-stone*, or *Agalmatholite*, or *Figure-stone*. It is also called *Briançon Chalk*, and *Venice Talc;* and it should interest you for more than one reason. In the first place, it has the property of absorbing fat and oily substances. It is used with advantage in taking out grease-spots from silks and woollen stuffs. Then again, Steatite reduced to an impalpable powder and coloured with Safflower (*Carthamus Tinctorius*, bastard saffron) constitutes *rouge*, a cosmetic my pretty Cousin has no occasion for, and which I know she would on no account employ. Indeed, if men, in general, were of the sentiment of the nobleman who, when asked his opinion of a beauty highly-rouged, replied, that "he scorned to be taken by an English woman under French colours," the ladies would altogether discard an artifice as injurious to their skins as to their

sincerity. Steatite is also employed in the preparation of pastils, and, prepared in a particular manner, serves also for painting on glass. In its natural state, glaziers use it for marking upon glass what they mean to cut. Tailors and habit-makers also employ it for tracing upon cloth, as marks made with this substance are not so easily effaced as those made with chalk.

The name of *Soap-stone* has been given to Steatite on account of its greasy feel, and also from its often having the colour and appearance of mottled soap. But it has a still more direct title to the appellation, as the Arabs use it in their baths to soften the skin. What is most remarkable, however, is, as you may perhaps have read, that certain people eat it. According to M. de Labillardière, the natives of New Caledonia eat a great quantity of a soft Steatite, and M. de Humboldt says the same thing of the Ottomaks, on the borders of the Oronoko. M. Goldberry assures us that the Negroes at the mouth of the Senegal mix a white Steatite with their rice, and eat it without any inconvenience. If this be not from necessity, it is certainly a case in which we may say, 'there is no disputing about taste.' Finally, Steatite is used for imitating engraved stones. It is easily cut, and is then exposed to a great heat, which hardens it to such a degree that it takes a fine polish; after which it may be coloured by metallic solutions.

The names *Briançon Chalk* and *Venice Talc*, would induce one to believe that this substance was found in these two localities; but the fact is, they are merely the markets for it: that from Briançon

comes from the red mountain (*Montagne Rousse*), which unites Fęnestrelle to Javin and the valley of St. Martin;—that of Venice is brought from the Mountains of Salzburg and the Tyrol; but it is also found in Saxony and in Silesia. *Briançon Chalk*, or *French Chalk*, is sold at Paris for six or seven sous the pound.

AGALMATHOLITE, or *Figure-stone*, or *Pierre de Lard*, or *Pagodite, &c.*, comes chiefly from China, where it is cut into figures, pagodas, &c. Its usual colour is red, or white, or both together, in bands and patches, generally dull, but sometimes bright; particularly the white and red, which colours are occasionally so disposed as perfectly to represent a piece of bacon.

MACLE or CHIASTOLITE.—This stone has nothing in common, as far as appearance goes, with those of which I have spoken to you; but from its nature it is classed along with the unctuous stones, though its composition has not been well determined. Macle takes but a dull polish; it has, nevertheless, excited much interest for two reasons: first, because the prisms, which are square, present, in the section perpendicular to their axis, a black cross on a white ground; and secondly, because Macle forms the armorial bearings of the house of Rohan, it being found in Brittany at a place called *Salles de Rohan*, in the Commune of Perret, near St. Brieux, in the department of Côtes du Nord. The Macles from Spain are cut into beads for chaplets, each one of which is marked with a cross. Sometimes in cabinets one sees them bored. It is probable they have served as amulets. Macle is

found in England, in Ireland, in France, in Spain, in Portugal, in the United States, in Peru, &c. The finest comes from St. Brieux, where it occurs in a rock resembling slate but harder; and as the crystals of Macle or Chiastolite are disseminated in all sorts of positions, polished slabs present the singular appearance of a kind of Hebrew writing.

TALC.—This substance, of little interest in itself, would hardly have found a place in this letter, were it not to put you on your guard against a very common error, that of confounding it with *Mica*. Talc is transparent when in thin flakes, and it may be split with ease into leaves of extreme fineness. Its colours are silvery-white, greenish-white, apple-green, asparagus-green, leek-green, and emerald-green. In Sweden a variety is found which is of a fine deep blue. It is shining, and its lustre is pearly, or semi-metallic; it is unctuous and greasy to the feel. *Mica*, on the contrary, is hard and dry. Talc is flexible, not elastic, like *mica*. The colour-suite of the two substances is also different.

Talc is found in many places in the four quarters of the world; it is applied partly to the same purposes as Steatite. The Chinese burn it, and take it mixed with wine, for the cure of diseases, and to procure long life. Our European doctors have also used it in medicine.

MICA is a substance very extensively distributed, as it forms a constituent part of the true granites, and exists also in a great variety of other rocks. It abounds in gneiss and mica-slate. Its usual colours are a yellowish- or greenish-grey, more rarely smoke-grey and ash-grey. It passes also from brown,

through blackish-brown, into absolute black. It occurs, also, yellowish-white and silver-white, and is sometimes met with green, and very rarely peach-blossom colour. It is found massive and in concretions, and sometimes regularly crystallized in prisms or tables with six or four sides. In Siberia, and on the borders of the Caspian Sea, Mica is found in very large sheets of three or four feet square. In this latter country, this substance is regularly quarried, and forms an article of commerce. The price varies according to the purity and size of the plates. In 1781, about 4,000 weight of it was shipped at St. Petersburg for Lubeck, and a considerable quantity was also sent to England and Ireland. It is employed in Siberia, as also in Peru, and in Mexico, for the same purposes as window-glass. It is also good for lanthorns, as it bears change of temperature better than glass. It is particularly well suited for glazing the windows of ships of war, not being subject to break with the percussion occasioned by the discharges of cannon. Very large plates of Mica are dear; those of ordinary size sell from six to eight francs (five or six shillings) each, on the spot.

It is also sometimes employed in the making of false avanturine, and for other similar purposes where it is required to produce the appearance of a gold or silver powder. Walls are sometimes powdered over with Mica, which gives them a pretty brilliant appearance; it is also employed as a sand to dry writing, for which purpose it is sometimes coloured. In the state of a very fine powder it is known as *Cat's-gold* and *Cat's-silver*.

Lepidolite or Lelalite is massive, but composed

of brilliant and pearly spangles, or little lamellar masses of a pretty lilac colour, and sometimes peach-blossom, of a very charming effect. It takes a pretty good polish, but, unfortunately, it is very soft, and the pieces are not large. It is worked into slabs, boxes, &c. It is found in Moravia, at Limosges, in Scotland, in Norway, in Siberia, &c.

I shall now conclude this letter, and, at the same time, what I had to say on the unctuous minerals, with a single word on *Meerchaum*, or *Ecume de Mer;* a subject which can have but little interest for you, but regarding which you may display your knowledge, when next you see your neighbour, old Captain W—, who, as you know, prides himself on the Meerchaum-pipe he received from Prince Blucher, but who certainly knows nothing whatever about it beyond its having been once the property of the famous Prussian Field-Marshal.

Meerchaum, then, is nothing more than Magnesia with Carbonic Acid and a little Silica. It is white, light, and being capable of forming a paste with water, is easily moulded.

There are two kinds of plastic Magnesia, the first is employed in the manufacture of porcelain, at Vineuf, near Turin and elsewhere; and the second is valued for the making of Turkish pipes. This latter is found more especially in the Crimea, as also in the neighbourhood of Thebes, in Greece, at Koniah, and in Anatolia.

The pipes are made upon the spot where the substance is obtained, particularly at Thebes, at Poli, and at Cesarea, and constitute a very important object of traffic. For the making of pipes, the sub-

stance is submitted to sundry processes, such as boiling in milk, &c. When new, the pipes are white, but they are not esteemed by amateurs till use has given them that yellow-brown tint which they are generally observed to have, particularly at their lower part. In Turkey, none but the lower orders smoke out of new, or white pipe.

This, I am sure, will be enough, on a subject which must remind you of what you hold in such horror, the smoke of tobacco. I think as you do, dear Cousin, that the constant habit of smoking, now so universal, has many objections. But so long as bad habits are fashionable, and serve to fill the coffers of the Treasury, it is not likely they will be put down. There are some, however, who pretend that they owe to the fumes of this narcotic weed their most brilliant inspirations, which, if you should happen to be a disciple of Azaïs, you will regard as a compensation.

LETTER XIX.

Loam, Potter's Clay—Plastic Clay—Fullers' Earth—Cimolite—Porcelain-Clay—Clay-slate—Shale—Rotten-stone—Tripoli—Polishing Slate—Mountain-Meal—Black Chalk—Lemnian-Earth—Bole—Ochres—Red Chalk—Terra de Sienna—Umber—Lithomarge—Wedgwood's Pyrometer.

IN the present letter I mean to call your attention to a mineral substance that, in outward appearance, is one of the least interesting; one, of which some varieties at least, are constantly before our eyes or under our feet, and which we are accordingly prone to regard as beneath our notice, though it is really one of the most useful, for an almost infinite variety of purposes—I mean *Clay*. Different substances are classed under what is called the Clay-family, or argillaceous minerals. I shall only speak of the more important.

The Clays in general have an earthy texture, and give out, particularly when breathed upon, a peculiar odour, which has been named from it, the Argillaceous Odour. They are composed chiefly of Silica, with a variable proportion of alumina, and a small quantity of lime or magnesia. They appear to be all of them mechanical deposits, and are never found crystallized. There is a pure Clay called *Aluminite*, but it is very rare, is found in very small quantities, and has no particular use.

LOAM.—This variety of common clay is so very abundant that no particular locality need be mentioned, nor need I dwell upon its aspect, which is

known to every one. Its uses are many and important. In agriculture it is invaluable when it exists in due proportion in the soil, for it then retains the necessary moisture, and prevents the earth from being removed from the roots of plants by wind and water. In many places it is used as a building-material; thus Babylon and its walls were constructed of merely sun-dried bricks; that is, loam fashioned into bricks, first dried in the shade, and then in the sun, without being burnt.

In Italy, France, and elsewhere, walls and houses are constructed in what is termed *Pisé* work, that is, of sandy loam beaten down between planks placed at the requisite distance for the thickness of the wall, the planks being shifted along and higher up as the work proceeds. These walls are so solid that some have been known to last for centuries. In our own country, as in Devonshire, there are walls of a similar kind, though they do not answer so well in our wet climate.

The property enjoyed by loam of being impervious to water, renders it also very useful for what is called *puddling;* that is, lining ponds, canals, and aqueducts, to prevent the loss of water by infiltration.

It is, so to say, from the effect of a natural puddling, that we are enabled to procure water by wells. The water which falls on the surface of the earth percolates through the sand, gravel, and other light superior soils, and continues to run down till it meets with a bed of clay, which arrests its further progress, and where, accordingly, it remains collected in a sort of subterranean reservoir. As these beds of clay lie at different depths, it is also necessary to sink wells

at different depths before water can be obtained. But not to go too far into this subject, I will only observe that the sinking of what are termed *Artesian wells*, depends entirely upon a knowledge of the direction of these water-holding strata, and the depth at which they lie; a knowledge acquired by the examination of the structure of particular basins. This, by the way, is one of the valuable applications of geological science, to which I would like to see it restricted, to the utter exclusion of those cosmogonic dreams into which it has been degraded.—But to proceed.

POTTER'S CLAY.—This is the next most valuable kind of common Clay, it is also called *Figuline.* Its colours are yellow, yellowish-white, grey of different tints, and sometimes, though very rarely, mountain-green. It adheres strongly to the tongue, and forms a paste with water; it occurs in beds of greater or less thickness in alluvial districts, and is found in most countries. Its use in the manufacture of bricks, of roofing, paving, and drain-tiles of every shape and size, chimney and flower-pots, sugar-moulds, coarse pottery, both glazed and unglazed, for culinary and other purposes, are too well known and too numerous to render any detail necessary. There are different kinds of this Clay, which, either alone or mixed with the powder of broken pots, with sand, &c., are made into stone bottles for Selters and other mineral waters, effervescing liquors, ink, blacking, &c.

At Balasses, between Tentira and Thebes, in Upper Egypt, there is a particular kind used in the manufacture of water-pots, which, like the *Alcarrazas* of Spain, and the water-jars of India and China,

are celebrated for their property of cooling the water kept in them; the secret of which is simply this. The pots are to a certain extent porous; the water oozes through them almost imperceptibly, but it comes to the outer surface and is there evaporated; and this evaporation it is which carries off much of the heat of the water. The pots made in Egypt are so cheap and so abundant that the walls of houses are constructed of them; rafts are also made of them for crossing and navigating the Nile. The water-jars of India and China are either round or egg-shaped, and are of immense size, being from three to five feet in diameter, and five feet high. The colours of Potter's Clay are chiefly due to iron, so that instead of losing them by fire, it becomes of a bright red. Those clays, however, which owe their colours to other principles, sometimes become white in the fire. To sculptors and modellers the Figuline Clay is of the greatest importance.

Plastic Clay *par excellence,* or Pipe-clay, is compact, almost greasy to the feel, and when dry, may be polished with the fingers. It forms a very tenacious paste. It is infusible in the porcelain furnace, and is applied to many purposes besides the making of pipes. One of its extensive uses is, for cleaning and whitening the leather belts, gloves, &c., of soldiers.

Fuller's Earth, or *Smectic Clay*, occurs massive, of a greenish-brown, or slate-blue colour. It is found at Nutfield, near Reigate, in Surrey; near Woburn, in Bedfordshire, and elsewhere. It has a greasy feel, and may be polished with the nail: it crumbles to pieces in water, but acquires no great

ductility. Its use in absorbing oil and grease is well known, and was once considered so important in the fulling of cloth, that the exportation of it was prohibited under very severe penalties. Its place is now in part supplied by soap. The peculiar properties of Fuller's Earth (called by the ancients *terra fullonia*, whence its name,) is due to the alumina it contains, which should not be less than a fourth or fifth of the whole mass. Jameson has a note from the Edinburgh Encyclopædia, where it is stated, that at one time the annual consumption of Fuller's Earth in England was 6300 tons, of which 4000 tons were sent from Surrey, the price being, in 1744, eight shillings per ton; and, in 1805, not above six shillings. The same author places this clay along with Steatite, with which it has in fact some analogy.

Cimolite, (so called from Kimoli, now Argentiera, a barren island of the Archipelago, whence the ancients obtained this species of clay), is of a pearl-white, its texture is somewhat slaty, it is tender, soft to the feel, and adheres strongly to the tongue. It was used by the ancients to take grease out of stuffs, and also in medicine, but is far inferior to Fuller's Earth.

Porcelain Clay I have already treated of under the article Felspar, of which it is a decomposition.

Clay-slate is a variety of indurated clay, formed apparently from deposition, and fissile in structure, that is to say, easily split into thin plates. It occurs only massive, and is of various shades of dull colours; the purple slates occasionally exhibiting spots and patches of green. Slate is very abundantly applied

to a variety of purposes, as it may be obtained, with comparative ease, in slabs of almost every size and thickness or thinness required. Its use as a material for writing in schools we are all acquainted with. Another most extensive use of Slate is for the roofing of buildings. In large slabs it is used as a paving stone, also by fishmongers for laying out their fish, being equally good for that purpose, and by no means so expensive, as marble. Dairies are also fitted up with it, and billiard-tables are made of it, which are not liable, like those of metal or wood, to be thrown out of level by atmospheric changes. For roofing, the slate is merely split, but for other purposes it is often polished and sometimes varnished; the polish is given with pumice. According to M'Culloch, the use of slates for roofing is entirely European. He says, "from the Hellespont to China inclusive there is not a single house slated;" which is the more remarkable, as Slate is as abundant in Asia as in Europe.

The principal Slate-quarries of Great Britain are in Cærnarvonshire; but there are others in Wales and different parts of England, as also in Scotland, though not of such good quality. A great quantity is exported both rough and in frames. Roofing Slates have different names, and the price depends, of course, upon the size and quality. There are very extensive Slate-quarries in the Ardennes in France, particularly at Rimogne, between Charlemont and Rocroy. When I visited this place many years ago, the perpendicular depth of the workings was 600 feet, or 900 in following the inclination of the strata. The bed of slate had been worked to the depth of 120 feet, without any indication of an approach to

its lower surface. The proprietor informed me that in good years he sold from twenty to twenty-five millions of slates, and in bad years from ten to twelve millions. The number of workmen employed was 300, who extracted about 100,000 slates per day. The price varied from sixteen to thirteen francs the thousand. M'Culloch says, (speaking of ten or twelve years back,) "the Welsh quarries belonging to Mr. Pennant employ 1500 men and boys; and other quarries in the same country employ 1620 men and boys." It is probable that the immense increase of building in the metropolis and elsewhere, of late years, and the continually new applications of slate, must have given great extension to the extraction of this material, and, accordingly, employment to a much greater number of workmen. All slate is not good for roofing; that which is porous, by imbibing water, splits by that water freezing in the cold weather; it also collects dust in sufficient quantity to form a soil for mosses and weeds, with which old slated roofs are often covered; and which, although it adds to the picturesque beauty of a cottage, is prejudicial to the durability of its roof.

SHALE, or *Slate-clay*, is a much softer variety of slate: its colours are the same with those of slate. It is a common accompaniment of the coal-formation, and often contains impressions of reeds, ferns, fishes, &c. Being much softer than slate, it is cut into slate-pencils. When free from lime and iron, and reduced to a powder, it forms an excellent material for making refractory fire-bricks, being an infusible compound of alumina and silica; one of the best examples of which is the schist known by the name

of *Stourbridge Clay*. Some Shale contains a quantity of Bitumen, whence it is called *Bituminous Shale*. When put into the fire it blazes, crackles, and emits a black smoke and bituminous odour. There is both a black and a brown variety, the latter is from Hampshire, and is called *Kimmeridge Coal*.

Rotten-stone, so well known to good housewives, as of use in cleaning and polishing, is analogous to *Tripoli*, though separated in works on mineralogy: it is supposed to be a decomposition of shale.

Tripoli, which, like Rotten-stone, is so extensively used for scouring brass and other metals, is, with other stones of similar nature, remarkable from the fact announced by Ehrenberg, of these friable homogeneous rocks being actually composed of the exuviæ or skeletons of infusoria. They are so perfectly recognized by the microscope, that their analogies with living species may be readily detected. They are in length about the $\frac{1}{288}$th of a line. It was first brought from Tripoli, but is now found in several places.

Polishing Slate is white, yellowish-white, and yellow; it is massive, and has, as its name indicates, a slaty texture; it is so light as to swim upon water, at least till, by capillary action, its pores become filled with the liquid. This substance is found in Bohemia, in Saxony, and in France, is supposed to be a volcanic production, and is used for polishing glass, marble, and metals.

Mountain Meal is found at Santa Fiora, in Italy. This singular mineral is so light as to be formed into floating bricks; it feels dry, is very hard, and is used in polishing silver.

Black Chalk has a slaty texture, is meagre to the touch, and soils the fingers; exposed to heat it becomes red. It is found in primitive mountains, in France, Spain, Italy, &c., and is used for drawing and painting: its streak upon paper is quite black.

Lemnian Earth, from the Island of Lemnos, now Stalimene, in the Mediterranean, is yellowish-grey, or white, with ochreous spots on its surface; it is earthy, dull, and meagre to the feel; it falls to powder in water, emitting minute air-bubbles. This is one of the minerals which has been in the highest repute for their wonderful properties, the greater part of which are merely imaginary. We are informed by Jameson, that, "even so early as the time of Homer this substance was used as a medicine against poison and the plague, and was then in as great repute in Eastern countries as it is at present. It was sold in pieces having the impression of a sacred seal; none but priests durst handle it, and severe punishments were inflicted on those who presumed to dig for it at any other than the stated periods. It is mentioned that Scultetus Montanus, physician to the Emperor Rodolph, in the year 1568, ordered this earth to be kept in apothecaries' shops. At the present day it is dug but once a year, in the month of August, in the presence of the clergy and magistrates of the island, after the reading of prayers. The clay is cut into spindle-shaped pieces of an ounce weight, and each of them is afterwards stamped with a seal having on it the Turkish name of the mineral." Brard says, that before the Turks took possession of this lucrative branch of industry, Christian priests, on the day of the Transfiguration, sallied out to a

place near the town of Respondi, and caused the earth to be dug out for the space of six hours only, in order to keep up the scarcity. They also stamped an impression upon it. Since the Turks have had the monopoly, there was a time when it was difficult to be had, as it was reserved for the sole use of the court of the Sultan.

If you ask me what is the origin of the reputation of the Lemnian Earth, I must inform you that, according to some, when it pleased Jupiter to kick Vulcan out of heaven, he fell on the island of Lemnos and broke his leg: it is really a wonder he was not killed, considering the height from which he fell; he was, however, cured by an application of the Lemnian Earth, from which event its reputation dates. Others, however, assure us that Philoctetes having hurt his foot by letting fall upon it one of the arrows left to him as a legacy by his friend Hercules, he was prevailed upon by Ulysses to remain at Lemnos, where his wound, which they say was a very bad one, was at length cured by this same earth.

The Lemnian Earth, as I have said, was considered sacred; this was because it was prepared by the priests; the impression stamped upon it (and whence it was called *Sphragis* in Greek, and *Terra Sigillata* in Latin,) was at first the effigy or head of Diana, who, as you know, was the tutelar goddess of the island. According to Hall, in a note to Theophrastus, the earth was formed into a paste with goats' blood before receiving the impression. At the present time, some say the individual pieces are not stamped, but that they are put into bags sealed with the seal of the Grand Signor. If Lemnian Earth, which is still

used in veterinary medicine, has any virtue it is merely as an astringent.

Though at the risk of repeating, I cannot refrain from giving you in his own quaint style, what was written about this *Terra Sigillata* by the traveller and poet, George Sandys, more than two hundred years ago.

"On our left, lay Lemnos, famous for the fabulous fate of Vulcan—

> 'Gainst Jove once making head, he caught me by
> The foote, and flung me from the profound skie.
> All day I was in falling; and at night
> On Lemnos fell: life had forsook me quite.

Whereupon, and no marvel, he ever after halted.

The Grecians there now inhabiting do relate

> (——What dares not lying Greece
> In histories assert?)

that he brake his thigh with a fall from a horse, on the side of a hill, which at this day beareth his name. The earth, in that place, thereupon receiving those excellent virtues of curing of wounds, stopping of fluxes, expelling of poisons, &c., now called *Terra Sigillata*, in that sealed; and there only gathered. In regard to the quality of this earth, which is hot, the island was consecrated to Vulcan, which signifieth fire. For the ancients expressed under these fables, as well the nature of things, as names of persons. As now, so heretofore, in the digging thereof, they used sundry ceremonies; ceremony which giveth repute into things in themselves but trivial. It was wont to be gathered by the priests of Venus: who, amongst other rites, did mingle the earth with the blood of a goate, (printing the little fillets whereinto

divided, with his form), which was sacrificed unto her. . . . .

"This hill lieth South of the ruins of that ancient Hephæstia, which gave a name unto Vulcan, and about three flight shots removed. Between which standeth Sotira, a little chappell frequented by the Greeke Coloieros upon the sixth of August; when they begin their orisons, and from thence ascend the mountaine to open the veine from whence they produce it; which they do with great preparations and solemnities, accompanied with the principal Turkes of the Island. That which couereth it being remoued by the labour of well nigh fiftie pioners. The priests take out as much as the cadie doth thinke for that yeare sufficient (lest the price should abate by reason of the abundance), to whom they deliuer it, and then close it up in such sort, as the place where they digged it is not to be discerned. The veine discouered, this precious earth, as they say, doth arise like the curling up of worms, and that only during a part of the day: so that it is to be supposed that they gather as much as the same will afford them. Certaine bags thereof are sent to the Great Turke: the rest they sell (of which I have seen many cups at Constantinople); but that which is sold to the merchants is made into little pellets, and sealed with the Turkish character. The ceremonies in the gathering hereof were first inducted by the Venetians."

It is Dioscorides who says the *Terra Sigillata* was stamped with the figure of a goat; but Galen says it was the figure of Diana.

Bole, which has a more greasy feel than the

Lemnian Earth, is much the same thing; it is found in solid amorphous masses of a yellow, red, or brownish-black colour. The yellow, says Phillips, is translucid on the edges; the red nearly so, and the brownish-black opaque. It occurs in Silesia, Hessia, and Italy.

OCHRES are clays very similar to the boles, but more highly coloured; that from Armenia, which is also called Bole, was formerly in great repute both as a pigment and as a medicine.

Red-Ochre, or *Reddle*, known to every one, is a clay strongly coloured by iron. The coarser kind is used by carpenters for marking out their work, and by graziers and farmers for marking their cattle, and other purposes. The finer kind is used by the painter. What are commonly called *Red Chalk Pencils* is a preparation of Reddle and gum. That which you use under the name of *Raw Terra de Sienna* is a yellow ochre, extremly fine in quality, found in small masses at Sienna; when torrified, it is the redder colour known as *Burnt Terra de Sienna*. *Umber*, another of the colours of your box, is also an Ochre, which some say comes from Ombria, in the Roman states; others pretend it is brought from the island of Cyprus; but the fact is, the locality is not exactly known. Good Umber has been found in Liguria, and elsewhere. *Burnt Umber* is much darker in colour than the raw material.

LITHOMARGE, or *Mountain-Marrow*, is of various colours, striped and spotted: it is massive, soft, adheres strongly to the tongue, is opaque, has a greasy feel, and is shining in the streak. It is found in Saxony, Bohemia, and elsewhere. I possess some

very beautiful varieties from Russia. It also occurs in some of the tin-mines near Redruth, in Cornwall, and forms an essential part of the Topaz rock of Scheekenstein.

Clay has the property of holding with great tenacity the last particles of the water that is mixed with it, and of contracting on being heated; a property that was taken advantage of by the celebrated Wedgwood for constructing a *pyrometer*, or measurer of high degrees of heat, such as he required in his furnaces. For this purpose small, and somewhat conical pieces of refractory clay, properly prepared, are placed in the groove of a metallic rule, the groove diminishing gradually in breadth, and the sides being graduated. Now as the pieces of clay contract by the heat of the stove in which they are placed, they slide further down towards the narrow end of the groove, and the number of degrees to which they slip indicates the heat of the furnace.

Thus, dear Florence, I trust I have sufficiently pointed out to you that the Clays and Argillaceous Minerals are by no means to be despised because they are not pretty. I am far from having mentioned all the kinds and their several varieties, but I have spoken of the more important, and indicated some of the uses to which they are applied. To have enumerated all the purposes to which the several varieties of the Argillaceous Minerals are put, would have been endless and fastidious. I will therefore now terminate the present letter: my next shall be on a mineral of the greatest value, though of little use.

LETTER XX.

The Diamond — The Brilliant — The Rose-Diamond — The Table-Diamond — Other Forms — Value of Diamonds — Bort — Remarkable Diamonds — Uses of the Diamond — Glaziers' Diamonds.

I PROMISED you, my dear Florence, that the present letter should treat of a mineral of great value, but little comparative use: it is of the Diamond I would speak; that sparkling gem which, on account of its brilliancy when cut and polished, and of its comparative scarcity, is so highly prized, and so justly considered the most beautiful and most precious of all the productions of the mineral kingdom. As it constitutes of itself the richest ornament of a lady's toilette, as well as the most valuable jewel of princes, it deserves to be treated of in some detail; and accordingly I shall devote the present letter exclusively to it.

By mineralogists the Diamond is classed among simple combustibles, being nothing more than pure crystallized Carbon. Boetius de Boot, in 1609, suggested that the Diamond was an inflammable substance. Boyle, in 1673, discovered that, when submitted to a high temperature, it was in part dissipated in acrid vapour. In 1694--5 experiments made in Tuscany confirmed the fact of the Diamond's combustibility. In 1704, our immortal Newton, unacquainted with the Tuscan experiments, suspected the Diamond to be a combustible body; a suspicion to which he was led from having observed that bodies

refracted light with so much the greater energy as they were the more combustible; and the Diamond having a very high refractive power, he concluded the combustibility of its nature. About a century afterwards, the suspicions of Boetius and Newton were fully confirmed by the experiments of Macquer and Bergman, followed by Lavoisier, Smithson, Tennant, Guyton de Morveau, Allen and Pepys and Davy, who not only succeeded in burning the Diamond, but ascertained it beyond dispute to be Carbon.

Carbon is a very abundant principle in nature; it is an elementary body, and is found pure only in the Diamond. In combination it exists in many of the gases, and in all vegetable and animal substances. It is the basis of common charcoal, is abundant in ordinary coal, and still more so in Anthracite coal, which is almost wholly composed of it. United with oxygen, it forms carbonic acid gas; 100 parts of which contain 28·60 of carbon and 71·40 of oxygen; and accordingly as chalk, limestone, and marble, are compounded of about 44 parts of carbonic acid and 56 of lime, every 100 parts of chalk, &c. contain 12·584 of Diamond, or pure carbon. I have, in a former letter, told you that our bones contain carbonate of lime, they therefore contain Diamond; nay more, as we give out a small portion of carbonic acid gas from our lungs at every expiration, so do we literally breath Diamond, whereas St. Chrysostom, whose name, as you know, means *golden-mouthed*, breathed gold only by a metaphor.

The Diamond, then, is pure carbon, but by what process Nature has effected the concentration and

crystallization of this pure elementary body, has never been discovered. Numerous attempts have been made to obtain Diamonds artificially, and, according to published accounts, not altogether without success, though those obtained have hitherto been so exceedingly small as to be of no use; nor would they be of much, if larger; for it is with this as with the philosopher's stone—if Gold and Diamonds could be manufactured, they would immediately sink in value.

Diamond is the hardest substance known; it will accordingly scratch every other body, but is itself scratched by none: to cut and polish it, therefore, recourse must be had to the powder of other diamonds. Together with extreme hardness it possesses a very high refractive power; and it is to this property of separating the rays of light into their prismatic colours, that this gem owes the brilliancy for which it is so remarkable. Its specific gravity is not great, being 3·53, or a little more than $3\frac{1}{2}$ times the weight of an equal bulk of water. Its refraction, single to all appearance, has been shewn by Sir David Brewster to be double, though only one image of an object is seen through it, for reasons we cannot here enter into. In its rough state the surface is often dull and uneven. It is found in grains and angular pieces, or crystals of greater or less regularity; the facets of some of the crystals are smooth, those of others are striated or granular. Fourteen different crystalline forms of the Diamond are enumerated, all of them derived from the regular octahedron. The facets of the crystals are often curved, which gives the crystals a spherical appearance. The structure is perfectly lamellar; it yields readily to cleavage parallel

to the planes of the octahedron; it is easily frangible, and the fracture is conchoidal; it burns, and is dissipated at a heat less than the melting-point of silver, viz. at 14^0 of Wedgwood's pyrometer; it is not acted upon by acids nor alkalies; and, some varieties at least, after exposure to the sun's rays, present in the dark a distinct phosphorescence.

The usual colour of the Diamond is white, or, more properly speaking, it usually is colourless, or slightly tinged, sometimes of one colour, sometimes of another. It also occurs coloured indigo-blue, rose- and cherry-red, clove- and yellowish-brown, ochre-yellow, orange-yellow, wine-yellow, lemon- and sulphur-yellow, siskin-green, asparagus-green, pistachio-green, leek-green, and mountain-green, brownish-black, pitch-black, and greyish-black. Of all these colours the pink is the prettiest, and is even more prized than a colourless one of the same size and purity; the green is also esteemed for its colour. The blue and the black are the most rare, more particularly the latter, which is very highly prized by collectors. The colours are generally pale and light, seldom deep, very seldom dark.

Diamonds seem to be confined to a few favoured localities. These are between Golconda and Masulipatam; near Parma, in Bundelcund, where the finest Diamonds have been found; in the vicinity of Ellore, and other places in the southern part of India; the peninsula of Malacca; the island of Borneo; the district of Cerro do Frio, and other places in the Brazils; and in the Ural Mountains in Russia. It was for a long time thought that no Diamonds existed beyond the Tropics, but the last-named locality

proves this opinion to have been erroneous. The soil in which Diamonds are found in the Brazils, and which is there called *Cascalho,* is an alluvium consisting of quartzose-gravel, mixed with oxyde of iron, and containing, besides the Diamonds, blue, yellow, and white Topazes, and grains of gold. The Diamond-beds of India are somewhat similar, though in some cases, as at the mines of Banaganpilly, it is a hard rock. In no case do the Diamonds lie at any great depth from the surface.

Till the beginning of the last century, all the Diamonds known came from the East; the Brazilian deposits being unknown till the year 1728, when those of Cerro do Frio were discovered by the Paulists, (Portuguese colonists celebrated under the name of *Grimperos*, for their enterprizing and successful researches). Diamonds have since been found in other places, as in the province of Goyaz, Matto Grosso, and St. Paul's, &c.; and at the present time Europe is, and has indeed for many years past, been chiefly supplied from the Brazils, the rich mines of India being nearly exhausted.

Lord Anson, whose voyages round the world were performed in 1740, 1, 2, 3, and 4, says, that in the washings for gold in the Brazils, the Diamonds found were for the most part thrown away, in perfect ignorance of their being such, a few only having been collected as curious pebbles, and used as counters. Some of these finding their way into Europe, their real nature was ascertained, and the Portuguese Government accordingly began to establish washings, and has ever since monopolized the products. In the beginning, the search for Diamonds was urged

with such activity that during the first twenty years more than 1000 ounces were discovered, which caused a considerable fall in the price. Baron d'Eschwège states, that from 1730 to 1814 the mines have furnished, on an average, 36,000 karats annually, whereas the official registers gave 19,000 karats a year, from 1801 to 1806; from which it would appear that, in latter years, there has been a great falling off in the produce. In the above accounts no notice is taken of the Diamonds that are smuggled. Quite lately we have heard of the discovery of new and very rich deposits of Diamonds in the Brazils.

Large Diamonds are very rarely found anywhere, particularly in the Brazils. Hardly more than two or three are met with in a year of the weight of from seventeen to twenty karats, and in two years not one perhaps of thirty karats. Generally, they do not exceed five karats, and the greater number are much below this. The finest known Diamonds have come from the East.

The mode of recovering the Diamonds is by washing, which is effected in different ways in different places. In the Brazils, the Cascalho is raked backwards and forwards on inclined planes, over which a stream of water is made to run. This water carries away all the earthy and lighter particles, leaving the gravel. The larger stones are then thrown out by hand, and the rest carefully examined for the Diamonds. This work is performed by slaves, under the inspection of overseers; and if a slave is so fortunate as to find a Diamond of seventeen karats, he obtains his liberty. Notwithstanding the strict surveillance, the best Diamonds are secreted and sold

clandestinely; most probably the overseers themselves connive at the fraud.

That the Diamond was known to the ancients there is no doubt, as it is mentioned by both Theophrastus and Pliny; the latter of whom, in stating whence it was brought, adds, that it was found accompanied by gold, which we know to be really the case; in other respects, however, his account of it is incorrect. But, be this as it may, the ancients were totally unacquainted with the mode of cutting and polishing it: even in the time of Charlemagne the process was unknown, as the clasps of that Emperor's mantle, still preserved in Paris, has four large octahedral Diamonds in their rough state. Nay more, the Diamonds worn by St. Louis, in the beginning of the 13th century, are said to have been uncut. But, in 1456, or, according to others, in 1476, (I have not for the present the means of ascertaining which is the correct date) one Louis Bergheim, a young man of Bruges, having observed the effect produced by rubbing one Diamond against another, conceived the idea of using diamond-dust instead of the powder of Corundum, said to be used by the Chinese and Hindoos for cutting and polishing the Diamond, and thus was the first Diamond polished in Europe by him. This stone is said to have belonged to Charles the Bold, who wore it on his neck, surrounded with three Ballas Rubies. He lost this precious jewel at the celebrated Battle of Morat, in Switzerland. The Bernese, who found it, sold it to some merchants of Augsburg, of whom it was purchased by our Henry VIII., whose daughter Mary brought it as a dower to Philip II. of Spain. Since

then nothing has been heard of it, though it is by some conjectured to be the Sanci Diamond, the history of which, as told by others, is, however, somewhat different. I shall give you the other version when I come to mention the Sanci Diamond.

Diamonds are now cut, at least in Europe, into three principal forms, the *Table*, the *Rose*, and the *Brilliant;* the first being the least, and the last the most, advantageous form for the production of that brilliant play of colours for which the Diamond is esteemed The forms depend upon the shape of the rough stone; if this be flat, the Table or Rose form is given, but if it be thick, it admits of the Brilliant.

The natural form best adapted for the production of a Brilliant is the octahedron, which, it would seem, is the original type from which the shape of a Brilliant was originally taken; for if we cut off a considerable portion of one of the pyramids of the octahedron and a smaller portion of the other, we shall have the general form of the Brilliant, without its lateral facets. Indeed, Brilliants are generally cut from the octahedral Diamonds, and the Rose Diamonds from the flat spheroidal stones.

The Brilliant has an upper or principal face, called the *Table*, which is octagon, and an under and much smaller face, called the *Collet*. Around the table-side of the Brilliant is a girdle of eight lozenge-shaped facets and twenty-four triangular ones. On the collet side there are four irregular pentagons, alternating with as many irregular lozenges radiating from the collet as a centre, and bordered by sixteen triangular facets adjoining the girdle; thus forming in all fifty-eight facets.

The regular Rose-Diamond is fashioned from those stones whose spread is much too great in proportion to their depth to admit of being Brilliant-cut without a great loss of substance. According to Mr. Jeffries, it is formed by inscribing a regular octagon in the centre of the table-side of the stone, and bordering it by eight right-angled triangles, the bases of which correspond with the sides of the octagon; beyond this is a chain of eight trapeziums, and another of sixteen triangles. The collet-side also consists of a minute central octagon, from every angle of which proceeds a ray to the edge of the girdle, forming the whole surface into eight trapeziums, each of which is again subdivided by a a salient angle (the apex of which touches the girdle) into one irregular pentagon and two triangles; thus forming fifty-eight facets, as in the Brilliant. The Rose-cut has, however, much less lustre than the Brilliant, owing to its want of thickness. The cut just described is said to have been practised at Antwerp more than 300 years ago; but there are other modes of Rose-cutting, which are used when the stone is too flat to admit of a collet. In this case, the lower surface is a level plane, and the upper is cut into twenty-four triangles, the whole terminating in a point at the top.

The Table-Diamond is the thinnest of all, having merely an upper and lower plane surface with a bevelled edge, or at most a row of triangles for girdle.

Besides these forms, there are others, such as the *pear-shaped*, used for drops, and other forms for pins, &c. Mr. Mawe remarks that the modern fashion is so much in favour of the superficial extent of a Bril-

liant, that the regular cut is now often abandoned. This may certainly give a greater surface, but must impair the fire and brilliancy of the gem, which mainly depend on depth.

In the East much more attention is paid to the size of a Diamond than to the regularity of its shape, and hence they are met with of many, to us, uncouth forms. The same consideration induces the Orientals to dissemble flaws and other defects in their Diamonds, by multiplying the number of facets rather than diminish the size of the stone by cutting away the defective part; and, accordingly, Diamonds coming from the East with an unusual number of facets are to be suspected.

In order to give the forms above-mentioned, the Diamonds are sometimes first roughly-shaped by cleaving off some of the facets; but this cannot always be effected, and is attended with some danger of injuring the stone. Sometimes they are sawed off with a bow and steel wire and diamond-dust; but this process is slow and tedious, for the wires are so soon worn through, that they require constant renewal. The more usual mode is by wearing down the facets on a horizontal disc or plate of cast-iron, fourteen or fifteen inches in diameter, whose surface is roughened by a fine sand-stone, and then charged with diamond dust and oil. This plate is turned at the rate of 200 revolutions in a minute, and, as it is large, a skilful workman can operate upon three or four Diamonds at a time. The completion of a single facet occupies some hours.

If the Diamond be so hard merely to cut and polish into plain facets, it must be much more diffi-

cult still to engrave it. The examples of engraved Diamonds are accordingly very rare. Jameson, from whose work I have taken some of the details given above, says on this subject, in a note, that "Govi cites an antique head cut on Diamond, in the possession of the Duke of Bedford; but that Lessing is of opinion that these pretended cut Diamonds are Sapphires or Amethysts" (colourless ones, of course).

James of Trezzo, says also Jameson, appears to have been the first who cut figures on the Diamond itself. Clement, of Biragues, in the year 1564, cut figures on the Diamond, and even so early as the year 1500, Charadossa cut the figure of one of the Fathers of the Church on a Diamond, for Pope Julius II. The artists Natter and Costanzi were also famous for cutting figures on the Diamond. For a long time Diamonds were sent to Holland to be cut and polished, but no workmen in this art now succeed better than our own.

Diamonds, like every other commodity, are subject to vary in price according to the demand and supply; and of late years, it seems the price has been somewhat on the increase, that is, for ordinary Diamonds; large ones have not been much sought after for some time. Notwithstanding this variation in the price, there is a mode of estimating the value of Diamonds which approximates pretty nearly to their average market-price. For Brilliants perfect and of pure water, the rule is, that a Diamond of this kind, of one karat, is worth £8; beyond this, the weight is to be squared, that is, multiplied by itself, and the product then multiplied by 8. Thus a Brilliant of two karats will be 2 multiplied by 2, and this by 8,

making £32. for the value of such a Diamond. One of three karats will be 9 times 8, or £72; one of four karats, 16 times 8, or £128, and so on; and a Diamond of twenty karats, will be worth, by this mode of estimation, £3200; and a Diamond of 100 karats £80,000. This mode of valuation is, however, rarely extended beyond twenty karats; Diamonds greater than this are valued arbitrarily.

Rough Diamonds selected as fine and well sorted for cutting, are valued by squaring the weight and multiplying by 2; the result will be the value in pounds sterling.

Bad Diamonds are called *Bort,* and, says Mawe, have a more extensive sale than Brilliants, in consequence of their extensive use in the arts; uses to which I shall advert presently. Some Diamonds, however, are foul without being in other respects bad, and it is said that such may be made clear by imbedding them in charcoal-powder, and submitting them to a strong heat. I shall now mention some of the most remarkable Diamonds known.

Remarkable Diamonds.—The Emperor of the Brazils, whose collection of Diamonds was, many years ago, considered most valuable, is said to contain one of the enormous weight of 1680 karats still uncut, and which, if valued, as it has been, at the rate laid down for a cut and polished Brilliant, would be worth £5,644,870. But it is conjectured, and with great probability, to be only a fine colourless Topaz.

The largest Diamond known to be really such is that belonging to the Rajah of Mattan. It weighs 367 karats, and, if valued as above, would be worth £1,069,512. It was found in Borneo. It is egg-

shaped, with an indented hollow near the smaller end, and is said to be of the finest water. We are informed by Jameson, that many years ago the governor of Borneo offered for it 500,000 dollars, two large war-brigs with their guns and ammunition, a certain number of great guns, and a quantity of powder and shot. But the Rajah refused to part with so valuable a hereditary possession, to which the Malays attach the miraculous power of curing all kinds of diseases, by means of the water in which it is dipped, and with which they imagine that the fortunes of the family are connected.

The next largest Diamond is that of the Great Mogul, which, before cutting, is said, by some, to have weighed 800, and by others, 900 karats, but which, being cut Rose-fashion, weighs $279\frac{9}{10}$ karats. It is 18 lines in diameter and $13\frac{1}{2}$ thick. It was found at Colore near Golconda, in 1550. Estimated as above, its price would be £622,000.

Next in weight comes the Diamond of the Emperor of Russia; it is said to have weighed, before cutting, 779 karats; it is now cut, and is egg-shaped, and weighs 195 karats. Estimated as above, it would be worth £304,200. According to some, it was bought for £90,000 and an annuity of £4,000 more. By some it has been valued at £4,804,000; but this is evidently from erroneously estimating it as a cut and polished stone of 779 karats. Elsewhere we read that twelve tons of gold and an annuity of 4,000 rubles was given for it. The first of these statements, however, is probably the most correct. Of this Diamond many stories have been told, but that which has gained the greatest currency is, that

it was one of the eyes of the idol of Jagernaut whose temple is on the Coromandel coast; that it was stolen thence by a French grenadier, who sold it for a small sum, and that, after passing through different hands, it at last came into the possession of the Empress Catharine. It at present surmounts the imperial sceptre.

The Diamond of the Emperor of Austria, and which formerly belonged to the Grand Duke of Tuscany, weighs $139\frac{1}{2}$ karats. Its estimated value would be about £155,000. This Diamond is of a lemon-yellow colour.

The next I have to mention, though not the largest, is, perhaps, the most perfect Diamond in the world. It is called the Pitt, or Regent; it weighs $136\frac{3}{4}$ karats, is $13\frac{1}{2}$ lines in diameter, and 13 lines thick. It is from the Pasteal Mine, in Golconda. It was brought from India by an English gentleman of the name of Pitt, and sold by him to the Regent, Duke of Orleans, for £130,000, according to some; but for only 2,250,000 francs, or £93,750, according to others. Estimated by the rule already given, its value would be about £148,000. It is now in the handle of the sword of state of the King of the French, which sword is decorated, besides, with 1,576 Brilliants, valued at 241,874 francs.

The last I shall mention is the *Sanci*. This also belongs to the crown of France; it weighs 106 karats, is said to be a very beautiful stone, and to have cost 600,000 francs, or £25,000, but is considered to be worth a great deal more; calculated by the rule of the square of its weight, it would be worth £90,368.

I told you that the Diamond first cut and polished in Europe was supposed to be this identical *Sanci,* and I then gave you one version of its history. Here is another and somewhat more interesting one.

"This Diamond, the Sanci, formerly belonged to Charles the Bold, Duke of Burgundy, who wore it in his hat at the Battle of Nancy, where his army was completely defeated, and where he lost his life, in 1477. It was found on the field of battle by a Swiss soldier, who sold it to a French gentleman of the name of Sanci. The Diamond was preserved in the family of this gentleman for nearly a hundred years, until Henry III. commissioned a descendant of that family, who was a captain in the Swiss troops in his service, to raise fresh recruits among the Swiss. Driven from his throne by a league which his subjects had formed against him, the monarch, without money to pay his troops, borrowed the Sanci Diamond, in order to pawn it to the Swiss. Sanci charged one of his servants to take it to its destination, but both the man and the Diamond disappeared, no one could tell whither. The king reproached Sanci bitterly for having confided an object of such value to a valet. But Sanci, full of confidence in his servant, set out in search, and discovered that the man had been assassinated by robbers, and that the body was buried in a neighbouring forest. Thither he went, ordered the body to be disinterred and opened, when the Diamond was discovered in his stomach ; the faithful servant having swallowed it, the more effectually to hide it from the rapacity of the brigands. From that time it has always been called the Sanci Diamond.

It ultimately came into the possession of an English monarch."

I vouch for the truth of neither of the two accounts of this Diamond, leaving you, my dear Florence, to credit neither, or to choose between them as you like best. Both stories state the Diamond in question to have belonged first to Charles the Bold, whose third wife was the daughter of our Edward IV., and to have subsequently belonged to an English monarch. The main difference is, that, by the first statement, the Diamond was lost at the celebrated battle of Morat, where the Bourgignons lost twenty thousand men, and which occurred in 1476; and that by the second, it was lost at the battle of Nancy, where the Duke was killed, in 1477. But enough of this digression. I will now say a word on the

Uses of the Diamond.—These are considerable. I have said that bad Diamonds are technically called *Bort*. This Bort, pounded in a steel mortar into a fine powder, is used by jewellers, lapidaries, and others.

Fine drills are made of minute splinters of Bort, which are used for drilling small holes in Rubies and other hard stones, for the use of watch-jewellers, gold and silver wire-drawers, and others who require very fine holes drilled in such substances. These drills are also used to pierce holes in china, where rivets are to be inserted, and for piercing holes in artificial enamel teeth, or any vitreous substance, however hard. Cameos and intaglios are also cut by its means, as well as all our seals. All the gems are cut and polished

by means of diamond-powder, which is likewise used for cutting rock-crystal for those superior spectacles called *pebbles*.

The Diamond itself, at the suggestion of Dr. Goring, has been fashioned by Mr. Pritchard into microscopes that are esteemed superior to any others.

I was once shewn by her Serene Highness the Princess Z— a ring bearing the miniature of the Empress Catharine, which was covered with a plate of Diamond by way of a glass.

That the Diamond is used by glaziers for cutting glass, you are well aware; but perhaps, like many others, you imagine that this is effected by the point of a Diamond; but this is not the fact. The Diamonds used by glaziers, though very small, are uncut stones, so set that the curved edge, formed by the meeting of two of the contiguous curved facets of the stone, shall be exposed. The line to be cut on the glass must present a tangent to this curved edge, and the Diamond be so held that the two opposite surfaces of the Diamond present the same inclination to the surface of the glass. The better to secure this position, glaziers' Diamonds are now mounted in a manner that a perfect tyro may use them with success. The depth of the line cut is about $\frac{1}{200}$ of an inch. It is asserted that Sapphires and Spinels, ground into the form of the Diamond's edge, will also cut glass, but they soon wear out. The glaziers themselves are obliged to use Diamonds of different quality for the different kinds of glass they have to cut. If I have dwelt upon this technicality more perhaps than might seem necessary upon this occasion, it has

been because I know many ladies who are in the habit of scratching their names and verses upon the window panes of country inns in their romantic rambles, and who thus not unfrequently break their Diamonds in the process. A Diamond point will scratch, but not cut glass; and though the Diamond be very hard, it is by no means difficult to break.

As I have had occasion to state that different coloured stones have been, and no doubt still are, sold for Diamonds, you may like to know how you can tell the true from the false.

In the case of cut Diamonds, the eye of the connoisseur will detect the Diamond from other stones; but for those who are not connoisseurs, it is often very difficult, if not impossible, to judge by the eye alone, not merely between a fine colourless Sapphire and a Brilliant, but between a Brilliant and a Paste, the latter being brought to such perfection as very nearly to equal the gem. Unfortunately, the dealers do not like tests to be applied to their gems; if they are honest they are offended by the suspicion, and if dishonest are naturally averse to detection. The best security is derived from dealing only with persons of established reputation. The following, however, in addition to the specific gravity of the stone, are the tests that may be applied.

Draw a fine file over the stone, and if it be in the least scratched or abraded, it is not a Diamond; if unaffected it is a true Diamond. If the specimen under examination be very minute, it may be placed between two half-crowns, or other flat metallic surfaces, and pressed between the finger and thumb; if

it be a Diamond it will be uninjured, if not, it will break and fall to powder.

In former times, superstition attributed to the Diamond many virtues, not but what it has some extraordinary power still. It has been supposed to protect from poison, pestilence, panic-fear, hallucinations, enchantments, &c. It calmed anger, maintained affection between man and wife, and was thence called the stone of reconciliation. A talismanic virtue was also attributed to it: when, under a favourable aspect, and under the Planet Mars, the figure of this divinity, or of Hercules surmounted by a hydra, was engraved upon it; in such case, it secured the victory to him who wore it, whatever might be the number of his enemies. It was even pretended that Diamonds engendered other Diamonds; (this is a *pendant* for the Peruvian emerald mentioned in a former letter;) and Rueus informs us that a princess of Luxemberg had some hereditary Diamonds that produced others at certain times (why not, if money makes money?) In the language of Iconology, the Diamond is the symbol of constancy, of strength, of innocence, and other heroic virtues.

You, no doubt, remember well the story of Sinbad the Sailor, or, as he is now called, Es-Sindibád, of the Sea. The story therein related may very possibly have originated in one long current in the East, and which is thus related by Marco Paolo.

"In the summer the inhabitants of Golconda ascend the mountains with great fatigue, as well as with considerable danger, from the number of snakes with which they are infested. Near the summit, it is said, there are deep valleys full of caverns, and sur-

rounded by precipices, amongst which the Diamonds are found; and here many eagles and white storks, attracted by the snakes on which they feed, are accustomed to make their nests. The persons who are in quest of Diamonds take their stand near the mouths of the caverns, and from thence cast down several pieces of flesh, which the eagles and storks pursue into the valleys, and carry off with them to the tops of the rocks. Thither the men immediately ascend, drive the birds away, and recovering the pieces of meat, frequently find Diamonds sticking to them. Should the eagles have time to devour the flesh, the place of their roosting at night is watched, and in the morning the stones are found among the dung and filth that drops from them."

With this story, dear Florence, I conclude this very long letter; but on such a subject as the Diamond I thought you would like to have more details than on subjects of less importance, in the eye of fashion at least. The exorbitant value set upon a mere stone, however rare and beautiful it may be, and the immense sums that have been given for Diamonds, sums which might have been so much better employed, would furnish matter for some moralizing; but be not alarmed, I have done.—Adieu!

LETTER XXI.

Graphite—Pencils—Sulphur—Vermilion.

THAT my last letter should have led you to a more minute inspection of the few Diamonds you possess than you ever before devoted to them, no way surprises me, and that you have taken a little malicious delight in pointing out that the old Dowager's necklace is not composed of Brilliants, as she calls them, but merely of thin Rose-Diamonds, is all very fair, considering her own talent for depreciating whatever belongs to others. I must, nevertheless, caution you against making any unnecessary display of the information you possess on any subject. Every sensible man must delight in the conversation of a well-informed woman; but display, even of knowledge, for display's sake, is the mark of a weak and vain mind, and is so much the more unbecoming in a woman, as it is rather for the treasures of the heart than for those of the head, that our sex pays devotion to yours. This little sermon is to make amends for the want of the moral reflection I might have tacked on to the end of my last, but which I spared you, in consideration of the length of that letter.

The Diamond, I told you, was a combustible body: mineralogists range combustibles into two classes, the Simple and the Compound; of the former, the Diamond is one, and Graphite and Sulphur belong to the same class. Of these two I now purpose to treat.

GRAPHITE, or *Plumbago*, or *Black-lead.*—The two latter denominations are absolute misnomers, for Graphite does not contain one atom of lead; it is, on the contrary, a percarburet of iron, being composed of 96 parts of carbon, and 4 of iron. Some Graphites, however, differ in the proportion of these ingredients, and some contain other principles, as Alumina, Silica, &c., and even in greater abundance than the Carbon; but these may be considered accidental.

Graphite is of a steel-grey colour; it occurs in kidney-shaped pieces, and sometimes crystallized in six-sided prisms and tables; it soils the fingers, and leaves a greyish-black trace upon paper, which may be effaced with crumb of bread or India-rubber; it feels greasy, and may be easily cut with a knife: it belongs chiefly to primitive rocks and to the coal-formation. It occurs crystallized at Pargass, in Finland, and in the United States; and in scales, like mica, at Arendal, in Norway. In other forms it is met with at different places; in America; in Invernesshire, Ayrshire, and Aberdeenshire, in Scotland; at Passau, in Austria; at Langdorf, in Bavaria; at Monte-Rosso, in Calabria; in Piedmont, in Andalusia, in France, Bohemia, Styria, Hungary, and Transylvania, and in Iceland; also at the Cape of Good Hope; at Tchutskoë Noss, in Asia; and at Ceylon, whence some of very fine quality has been imported. The best quality of Graphite, however, is that which is found at Borrowdale in Cumberland, where it occurs in a bed of trap alternating with clay-slate. Dr. Ure, on the subject of this mine, has the following, which I extract textually for you.

"The mountain at Borrowdale," he says, "in which the Black-lead is mined, is 2000 feet high, and the entrance to the mine is 1000 feet below its summit. This valuable mineral became so common a subject of robbery about a century ago, as to have enriched, it was said, a great many persons living in the neighbourhood. Even the guard stationed over it by the proprietors was of little avail against men infuriated with the love of plunder; since in those days a body of miners broke into the mine by main force, and held possession of it for a considerable time.

"The treasure is now protected by a strong building, consisting of four rooms upon the ground floor; and immediately under one of them is the opening, secured by a trap-door, through which alone workmen can enter the interior of the mountain. In this apartment, called the dressing-room, the miners change their ordinary clothes for their working dress, as they come in, and after their six hours' post or journey, they again change their dress, under the superintendence of the steward, before they are suffered to go out. In the innermost of the four rooms two men are seated at a large table, sorting and dressing the Plumbago, who are locked in while at work, and watched by the steward from an adjoining room, who is armed with two loaded blunderbusses. Such formidable apparatus of security is deemed requisite to check the pilfering spirit of the Cumberland mountaineers.

"The cleansed Black-lead is packed up into strong casks, which hold one cwt. each. These are all dispatched to the warehouse of the proprietors, in

London, where the Black-lead is sold by auction, at a price of from 35*s*. to 45*s*. a pound.

"In some years the net produce of the *six weeks'* annual working of the mine has, it is said, amounted to £30,000, or £40,000."

Graphite, being a carburet of iron, is not unfrequently found lining the blisters of steel bars, these latter being prepared by violently heating iron-bars in charcoal powder.

Graphite is also sometimes formed in what is called the humid way: thus, the iron shoes of old piles which have been long under water are sometimes found converted into a kind of Graphite; and we are assured by Fabroni, that in the Neapolitan States there are certain wells in which an acidulated water collects, and at the bottom of these wells Graphite is found, which is extracted every six months.

Graphite is applied to various purposes, but its chief value is for pencils: for the formation of these the Graphite is, according to some accounts, first boiled in oil, and according to others, calcined in close vessels at a bright-red heat; (probably both methods are employed, according to the quality to be given to the pencil;) it is then sawed, by means of very thin saws, into rods of different sizes and shapes, according to the purposes for which the pencil is required. The rods are usually square in their transverse section, but of late years some have been made flat for a peculiar kind of drawing, and others cylindrical for the ever-pointed pencils. The slips thus cut are let into grooves of the proper size, in pieces of cedar-wood, over which another piece is glued. The

pencil is then finished off into the shape required, which is usually cylindrical, though sometimes square, and sometimes oval, &c. Some foreign pencils are imported that are varnished externally.

The best pencils are of course made of the best Graphite, and this, or the lead as it is called, is in one, or at most two pieces. An inferior kind is made up of short pieces; these may be equally good in quality, but are very wasteful. The worst kind are made of the powder which results from the sawing, mixed up into a paste with sulphur, gum, or fish-glue; these are always gritty.

You are not to imagine that even the best lead is of uniform quality. Good lead differs in hardness and in intensity of colour, and this is fortunate, as these differences are required in the arts; and still further to multiply them, recourse is had to a variety of processes: what are called prepared pencils may now be had of every possible kind. M. Conté and M. Humblot, of Paris, some fifty years ago discovered a method of making artificial pencils of very superior quality, the interesting details of which, if you are curious to know them, may be found in Dr. Ure's *Dictionary of Arts, Manufactures, &c.* It is very probable that our own prepared pencils are made in a somewhat similar manner to that described by Dr. Ure.

I trust these few details respecting Black-lead Pencils will not prove unacceptable to you, who can so well appreciate their value, and who have employed them with so much skill in your spirited sketches from nature. I cannot, however, quit the subject without informing you of a curious use to

which pencils were once applied, and which you would not readily suspect.

Some years ago a great number of forged notes of the Imperial Bank of Russia were clandestinely introduced, no one knew whence or how. At length intimation was given by the Russian Government to the Custom-House authorities at the port of Cronstadt, that a certain vessel would shortly arrive from England with a miscellaneous cargo, and among other objects several gross of black-lead pencils; and it was ordered that when these pencils arrived they were to be broken. In due time the vessel arrived, the box of pencils was landed, and there, according to order, were broken, when, to the no small astonishment of the official, each pencil was found to contain a bank-note tightly rolled up. The pencils had black-lead at each end, bore the stamp of a maker, and in all respects were externally so like ordinary pencils, that no suspicion could have been entertained; nor would this ingenious fraud have been detected, had not private information been given to the Russian Government.

The exportation of English pencils was at one time, and perhaps still is, very considerable. France alone, in 1789, took to the amount of 200,000 francs' worth annually; but that country now manufactures for itself the greater part of the pencils it requires.

Besides the use of Graphite in the manufacture of pencils, it is, as I have said, employed for other purposes; thus, the inferior qualities are very extensively used for the blacking of grates, stoves, &c., which it secures from rust, while it gives them a clean and bright appearance. It is also used for imparting

to stoves made of baked clay the appearance of being made of iron. It is likewise employed, mixed up with grease, for diminishing the friction of machinery; and, mixed with a due proportion of clay, it is made into crucibles, which resist sudden changes of temperature, and are employed by smelters, particularly for the purposes of the mint.

Lastly, it is employed for preparing moulds to receive the electrotype copies of medals, &c. This last application was first suggested by the ingenious Mr. Murray, the assistant to Mr. Newman, optician and philosophical instrument maker of Regent-street.

SULPHUR, or *Brimstone.*—This latter name is, according to Johnson, a corruption of Brin or Brenstone, that is fire-stone, and this is very probably the case, as we find in Horne Tooke's *Diversions of Purley*, that to *brin* or to *bren* formerly meant to burn. Sulphur is too well known to need any very minute description. It is of a yellow colour, somewhat inclining to greenish; though, according to its geognostic locality and other circumstances, it presents various tints of yellow. It is about twice the weight of water, and acquires vitreous electricity by friction. It is found massive, disseminated and crystallized, also coating other minerals, and occasionally in stalactitic concretions, and as an efflorescence. The purer varieties are transparent; the others pass through all the gradations of translucidity to perfect opacity. Sulphur occurs either in company with salt and gypsum in the formations where these exist, or in extinct or active volcanic regions; it is also deposited from certain thermal springs. The crystals of Sulphur vary in size from very small to several inches

in diameter. Some of the finest crystals are from Conil, near Cape Trafalgar, and from Murcia, in Spain. Sulphur is found in a great many localities, in Europe, Asia, Africa, and America. In Iceland it is particularly abundant. The great Sulphur deposits of Volcanic regions are called *Solfataras;* and it is from those of Sicily and Naples that Europe is principally supplied. In 1820 Sicily produced 70,000 tons of Sulphur, of which Great Britain consumed 40,000 tons.

Crude Sulphur is rarely sufficiently pure to be employed in the arts; it is, therefore, subjected to refining processes, the results of which are the *roll-brimstone*, and the *flour of Sulphur;* the former is obtained by a process of melting, the latter by sublimation.

Sulphur also exists in a state of combination with other minerals, particularly with iron and copper, forming those sulphurets called iron pyrites and copper pyrites; from these it is extracted, but in comparatively small quantities.

Sulphur is a very important mineral. Its principal uses are for the manufacture of gunpowder and fire-works, and for the making of sulphuric acid or oil of vitriol, a substance extensively used in the arts—for the making of vermilion, &c. In the composition of gunpowder Sulphur enters for one-tenth, and the quantity employed in time of war is prodigious.

Sulphuric acid is obtained by burning Sulphur and nitre together, and in this operation the Sulphur enters for nine-tenths. Vermilion is that beautiful colour so extensively used in painting, and with

which sealing-wax is coloured; it is formed by combining Sulphur and Mercury together by certain processes long kept secret, and which are not yet well understood, it is said, in France. The Chinese vermilion is reckoned the finest, but the Dutch and ourselves also manufacture a very excellent kind. In one establishment alone, in Holland, 48,000 pounds' weight of vermilion were annually manufactured.

An immense quantity of Sulphur is used for the making of matches, more particularly since the improvements in this useful article has promoted it from the kitchen to the parlour, the library, and the boudoir.

When Sulphur is burnt, it generates sulphureous acid gas, which is extensively used in bleaching; and you may not be sorry to know that the red stains from fruit may be removed from handkerchiefs, or other white linen or cotton articles, by moistening the stain with water and holding it over burning Sulphur. Straw-bonnets are also whitened in the same way, being first well cleaned.

This same sulphureous vapour is said to destroy moths and other insects that are apt to get into our wardrobes, beds, &c. For this purpose, every opening must be hermetically closed, and all coloured hangings, silks, chintzes, &c., removed, or their colours will be destroyed; pans of burning Sulphur are then placed in the room, which is left closed for a certain time, so that the vapour may penetrate every crack and cranny.

Architects and builders employ Sulphur for sealing iron cramps into stone.

Sulphur is also used in medicine, and most schools

know something of it, either in the shape of brimstone and treacle, or as an unguent for cutaneous eruptions.

By artists and amateurs it has been much employed, either of its natural colour or made red with vermilion, for taking casts of medals, coins, and antique gems, or making moulds for impressions in Plaster of Paris.

Finally, and this is worth remembering, Sulphur supplies the most instantaneous and efficacious method of extinguishing fire in a chimney. However violently the chimney may be blazing, throw on the fire in the grate two or three handfuls of sulphur in powder, and the fire is extinguished as by magic. I have often had occasion to test its efficacy, and there is always a box of sulphur in powder suspended near my kitchen-fire to be ready when wanted.

Sulphureous vapour tarnishes both gold and silver, and that a good deal of it is given out by our coal-fires is sufficiently evinced by the tarnish which silver, exposed in our rooms, soon acquires.

Sulphur is not confined to mineral substances: it exists also in both animal and vegetable bodies. It is the sulphur contained in the yolk of an egg that so suddenly blackens the silver spoon we use in eating it. Cresses and horse-raddish contain Sulphur.

Sulphur was known to the ancients, and superstition has applied it to the pretended purification of criminals.

LETTER XXII.

Coal—Compact Coal—Fat-Coal—Dry-Coal—Abundance of Coal in Great Britain—Safety-Lamp—Anthracite.

IN the present letter, my dear Florence, I purpose treating of a mineral which in real value stands pre-eminent over every other—I mean *Coal.* Diamonds, despite their beauty, their rarity and their price, are as inferior in importance to this black, earthy, abundant and comparatively cheap article, as gold, notwithstanding its almost unlimited and irresistible power, is inferior to iron. To coal and iron Great Britain owes much of its greatness among the nations of the earth; and it may be satisfactorily shewn that but for these minerals, so abundantly dispersed over the earth, science and civilization could never have reached the state of perfection to which they have now arrived. At present, however, I shall confine myself to the subject of Coal, which, as Dr. Ure says, "is the most valuable of mineral treasures, that which, at least in Great Britain, makes all others available to the use and comfort of man."

To treat *in extenso* of Coal, you can easily imagine would be to write a thick volume upon it. Such is not my object, nor is it likely you would read a work of the kind were it laid before you: but, as even the little general information you may wish to acquire regarding Coal can only be gleaned by wading through many scattered books, I mean to save you the trouble of research by taking it myself, and

present you with the result in a very abridged statement of a few of the more important facts.

Coal, or *Pitcoal* as it is sometimes called in contradistinction to charcoal, is a substance of vegetable origin, having every appearance of being the mineralized remains of antediluvian forests. The precise manner in which Coal has been formed is not known; but from certain appearances manifested in deep peat-bogs, whose lower portions much resemble coal, it would appear that great pressure, heat, and time, have been among the chief agents in the formation of Coal. In many places the species of plants or trees which have been converted into coal are still quite evident; and in all cases wood and coal have the greatest affinity, the principal ingredients of both being Carbon and Hydrogen, though the proportions of these are different in the several kinds of Coal.

The varieties of Coal are exceedingly numerous: thus it is said that there are no fewer than seventy species imported into London, of which forty-five are sent from Newcastle. The distinguishing features of many of these are, however, scarcely discernible, and very few of them are really important.

The general character of Coal is as follows. It is black, shining, moderately hard, and has a specific gravity of about 1·3; it burns easily, giving out flame and smoke with a peculiar bituminous, and, in some cases, sulphureous odour; and after burning leaves a cinder or white ash. By distillation, it gives out an empyreumatic oil, ammoniacal gas, and sometimes sulphureous acid gas, with ammonia. Coal has never been found crystallized, is always massive,

having sometimes a slaty texture, and often a conchoidal though more generally a straight fracture. In the latter case, the mass generally divides into parallelopipedons of considerable regularity. Some specimens exhibit very beautiful iridescent colours. The species *Coal* has been subdivided by different mineralogists; but for all practical purposes it may be divided into three kinds, to one or other of which all the varieties may be referred. These three kinds are *Compact* Coal, *Fat* Coal, and *Dry* Coal.

COMPACT COAL is of a greyish black, and without lustre, its fragments are sometimes largely conchoidal, and sometimes straight, with an even surface; it is solid without being hard, and, though compact, is very light; its specific gravity is about 1·2. It is easily cut and takes a good polish; burns well with a brilliant flame, gives out but little heat, and leaves hardly any residuum. This Coal very much resembles jet, only it does not give out, in burning, the same penetrating and disagreeable smell that proceeds from jet. It is also called Cannel Coal, and, in Scotland, Parrot Coal.

FAT COAL is light, brittle, very combustible, and burns with a long white flame, or gives out a great deal of smoke if the fire be not brisk. It swells and seems to enter into a kind of fusion, while it runs together or cakes. It leaves little residuum, and yields by distillation bitumen and ammonia.

DRY COAL.—This kind of Coal is both heavier and more compact than the first kind; it is sometimes less intensely black, approaching to iron-grey; it burns with difficulty and without swelling or caking, and leaves a considerable residue. There is

scarcely any flame from it, and what there is, is bluish. By distillation it gives out neither ammonia nor bitumen, but sulphureous acid only.

Coal is always found in mass, sometimes in heaps, but generally in strata, and very rarely in veins. The strata are inclined in various directions, dipping slightly, and contorted in every possible way.

Coal is almost everywhere accompanied by the same kind of rocks, known by geologists as the Coal-formation. The extent of country over which Coal is spread is called a *Coal-field.*

Coal is found in many parts of England; the chief repositories are those of Northumberland and Durham, from whence London and most parts of the South of England are at present supplied; the other localities are Cumberland, which sends large quantities to Ireland, Staffordshire, Derbyshire, Lancashire, Leicestershire, Worcestershire, &c. In Scotland, Coal is found in the Lothians, Lanarkshire, Renfrewshire, Ayrshire, and other counties. South Wales abounds in Coal, but a great portion of it is of a particular kind, called *Stone Coal*, or *Welsh Culm*, or Anthracite, of which I shall say a few words presently. In Ireland, Coal is, generally speaking, both deficient in quantity and inferior in quality. Peat is the common fuel in Ireland.

Belgium is rich in Coal, there being between 350 and 400 mines at work.

Germany, taken as a whole, is not so well provided by nature with this valuable mineral, though there are some important Coal-fields, as those near Sarrebrück and in Silesia. Saxony, Bohemia, Austria, the Tyrol, Bavaria, Hanover, the Hartz and

Hungary, have all of them Coal Mines, but they are insignificant.

Sweden, Norway, and Northern Russia, have hardly any Coal. It is said to exist in the Island of Bornholm in the Baltic; but the beds are so broken up by convulsions of nature, that it is next to impossible to work them. The same thing has also been asserted of the Coal-fields lately examined in Southern Russia.

Italy, Piedmont, Savoy, Switzerland, Spain and Portugal, have no Coal-mines of any importance.

Marco Paolo asserted the existence and employment of Coal in China, and Du Halde and later travellers assure us that no country in the world is so rich in this important production. Quite recently it has been found in the Archipelago, where its existence will most materially advance the progress of our steam-navigation in those distant regions. Japan possesses Coal, and it exists also in Australia.

Greenland, Canada, the United States, and the West Indies, have Coal. So likewise has Madagascar, and hopes are entertained of finding it in Egypt.

France, in 1821, produced annually 9,000,000 quintals of Coal, the quintal being 204lbs., Belgium 12,000,000, and England 75,000,000. Since then, however, the immense extension of the application of steam to machinery of every kind, to navigation, and to railways, has increased the consumption of Coal to a vast amount; it is at present estimated for Great Britain at 25,000,000 tons annually! About fifteen years since, it was 15,580,000 tons, of

which Durham and Northumberland alone supplied near 4,000,000 tons. The number of persons directly engaged in the coal-trade was at the same epoch estimated at about 170,000.

The importance of Coal, both as a necessary of life, and for the supply of the arts and manufactures, on which our prosperity as a nation so much depends, naturally gave great interest to the question, as to the period when our Coal-mines would be exhausted. The subject has accordingly been examined into, and it would appear that the Coal-fields of Durham and North Cumberland alone are competent to the production of an annual supply of 3,500,000 tons for a period of 1727 years; but as, in the opinion of some, this statement is exaggerated, we will leave out the odd seven centuries, and say 1000 years. It has further been estimated that the Coal-fields of South Wales would supply fuel, at the average rate of our present consumption, for 2000 years, after all our English Coal-mines are worked out!

I must not attempt to enter upon any details as to the mode of working Coal-mines. I will content myself with remarking that it is a very dangerous occupation, in consequence of what is called *fire-damp;* an explosive gas which is generated in the mines, and which, upon the approach of a candle, explodes with terrific violence, frequently occasioning great loss of life. It was with a view to the prevention of these fatal accidents that the celebrated Davy invented the lamp of which I spoke to you in a former letter, the principle of which is the curious fact, that the flame of a candle will not pass through a wire-gauze; and accordingly, by surrounding the

lamp with such a gauze, the danger of explosion is greatly diminished.

The ancients do not appear to have known the use of Coal, and unless we believe, with Brandt, that it was used by the ancient Britons, it was not employed by us till the time of Henry III. Some place the first discovery of Coal at Newcastle-upon-Tyne, in 1234, and others in 1239, while others again assert, that in the reign of John the coal-trade had already made rapid progress. Be this as it may, it appears that about the end of the thirteenth century it began to be employed in London, but at first only by smiths, brewers, dyers, soap-boilers, &c.; but the innovation was complained of as "injurious to human health," and in 1316, Parliament petitioned the King, Edward I., to prohibit the burning of Coal. A proclamation was accordingly issued against the use of *Sea-Coal*, as it was then termed. But such were the advantages of Coal and the high price of timber, that the proclamation was little regarded, and, in 1400, it was generally burned in London. In the reign of Charles I. (1625), Coals were in common use in England, and this fuel is now universally employed except in certain parts of Scotland and Ireland, where peat is abundant and cheap.

Of the uses of Coal it would certainly be quite needless to speak, except in a general way. Thus it is used for the generation of steam, which is now the great propelling power of locomotion by land and water, and the prime mover in machinery of every kind; for the smelting of ores and all the processes of metallurgy; for the lighting of our cities and public buildings with gas; and as fuel for domestic purposes.

Cannel Coal, on account of its taking a fine polish, is worked into vases, pedestals, boxes, trays, ink-stands, and a variety of similar articles.

I will merely add that various substances are met with in Coal. Thus oxidulated copper is found in the Coal of Schemnitz, in Saxony; sulphuret of mercury, or cinnabar, in that of Idria, in Carniola; native silver in that of Hessia; gold in that of Reichenstein, in Silesia; sulphuret of lead in that of Buckinghamshire, in England; antimony in that from near Cape Breton, in America. The most common, however, of the extraneous substances found in Coal is sulphuret of iron or pyrites, which are very prejudicial, as Coal containing it cannot be used in the smelting or working of iron without deteriorating its quality. Moreover, the pyrites, by decomposition in the bowels of the earth, occasionally give rise to a spontaneous combustion of Coal, producing phenomena something analagous to those of volcanoes. There are various examples of these burning strata.

Thus, my dear Florence, I have given you a very brief and incomplete statement, regarding a subject of such immense importance as Coal. Brief, however, as it is, it will, I trust, be sufficient for you. I will therefore now pass at once to other objects which are naturally connected with it; and first of

Anthracite.—This substance is very singular: externally it has much of the appearance of Coal, and has accordingly been called in Staffordshire, *Stone Coal;* in Scotland, *Blind Coal;* and in Ireland, *Kilkenny Coal.* In Wales it is called *Culm.* Nevertheless it has, if we may say so, a physiognomy of its own, and different, consequently, from that of Coal

properly so called. Its colour is iron-black, sometimes inclining to brownish; it is often superficially tarnished, and has occasionally a splendent metallic lustre. Its fracture is more or less conchoidal, and its specific gravity from 1·4 to 2·5. It burns with very little flame or smoke, and leaves a white ash. It is essentially composed of carbon, of which it contains from 68 to 97 parts in the 100; the rest being either silica or alumina, and, in some specimens, a very little iron; this last circumstance, together with its dry feel, distinguishes it essentially from graphite, which, in other respects, it nearly resembles. It occurs in both primitive and secondary formations; sometimes in beds, sometimes in veins, and sometimes disseminated.

Anthracite contains no bitumen, and the only product of its combustion, as in the case of the diamond, is carbonic acid gas. It presents no indication whatever of a vegetable origin, such as we find so commonly in Coal, nor can many of the positions and rocks in which it is found be reconciled to any idea of a mode of formation having any resemblance to that of Coal. Moreover, it is extremely difficult to ignite, and can be burnt only in large quantities and by the aid of strong blasts of air. It is therefore a mineral *sui generis,* and from its being composed almost exclusively of carbon, is placed by some in the list of simple combustibles, along with the diamond, graphite, and sulphur.

Notwithstanding the difficulty of igniting Anthracite, it not only burns when proper means are applied, but gives out an immense heat when it is ignited, and from its peculiar nature is applicable

with advantage to various purposes, and is accordingly now used in considerable quantity.

As it is found of different textures, as slaty, columnar, &c., mineralogists have divided it into a number of sub-varieties, which I need not detail to you further than to state, that a kind has been met with crystallized in regular six-sided plates, in erratic blocks of granite at Sardam in Holland, which blocks are supposed to have come originally from Norway.

Anthracite is abundant, as I have already hinted, in Wales, as also in the Alps and in the United States; in all which places it is employed with great advantage.

I had intended completing what I had to say on the combustible minerals in the present letter, but as I now find I cannot do so, without making it of an inconvenient length, I shall reserve the rest for my next communication.

LETTER XXIII.

Lignite—Jet—Fibrous Lignite—Earthy Lignite—Bitumen—Naphtha—Petroleum—Maltha—Asphalt—Elastic Bitumen or Mineral Caoutchouc—Retinasphalt.

YOU may regard the present letter, my dear Florence, as a continuation of my last; for although every subject may be considered by itself, and although I have not altogether followed out any scientific arrangement, I have, nevertheless, endeavoured to group the minerals, of which I have spoken to you, in a certain order, founded upon their more striking characteristics. The substances of which I am now about to speak belong to the group of the compound combustible minerals, at the head of which stands the Coal, treated of in my last, and to which I added Anthracite, as being practically considered a kind of the same mineral.

Lignite, though classed by some mineralogists along with coal, has, however, peculiarities which distinguish it sufficiently from that mineral. The odour which it emits in burning is styptic, often fetid, and has no analogy with that given out by coal and bitumen. It burns with a bright and sometimes greenish flame, but does not swell like coal, nor run, like the solid bitumens. It leaves for residuum a pulverulent ash, similar to that of wood, but often more abundant, more ferruginous, and more earthy; and seems, in some varieties at least, to contain a little potash. By distillation, it furnishes

an acid, which coal does not. The colour of the Lignites varies from the most intense black to an earthy brown yellow, and the texture of the greater number of them indicates the woody origin, whence their name is derived. The fracture is compact, often resinous, and conchoidal, or brilliant, and straight. The external characters of the different varieties are very dissimilar. Of these varieties, I will mention only the two or three most important.

JET is interesting from the uses to which it is applied; it is hard, solid, and opaque, and very little heavier than water: indeed, some specimens will float. It is so black as to have become an object of comparison—" Black as Jet" being a very common expression. It is susceptible of receiving a very beautiful polish. It bears much resemblance to Cannel Coal, from which, however, it differs in reality, as I pointed out to you in my last. In some specimens the woody tissue is distinctly observable; and in those where this is masked by the bitumen with which it is impregnated, it becomes apparent after distillation.

Jet is found in detached masses of moderate size in beds of marle, bituminous shale, lime-stone, sand-stone, and secondary trap. Its principal localities are Languedoc, the Asturias, and Gallicia; but it occurs elsewhere, and, among other places, in Hessia, Bavaria, Bohemia, the Saxon Erzgiberg and Styria; as also in England, near Whitby; in the Isle of Skye, in the Faroe islands, and Iceland. It likewise occurs at Massachusetts, in the United States. I will not positively state that in some of these localities Cannel Coal may not have been mistaken for real

Jet. Nowhere has it yet been found in sufficient abundance to be used exclusively as fuel.

The name of Jet is said to be derived from the river Gaga, or the city Gagas, in Asia Minor, where it was formerly dug. By the Prussians it is called Black Amber, being found by them in small quantities along with the yellow amber. By Dioscorides and the ancients it was called Gagates.

Jet is susceptible of being worked on the lathe, and of being ground down and polished; and, from its fine black colour, was manufactured in the departments of Aude and the Higher Alps into buttons, necklaces, rosaries, crosses, ear-drops, bracelets, clasps, rings, snuff-boxes, drinking-vessels, and a great variety of similar objects. In Spain it is called *Azabache*, and, in the Asturias, it is worked in the same manner as in Languedoc. In Persia, also, it is cut into various ornamental articles.

Some years ago, 1,000 cwt. of Jet was consumed in France for ornamental purposes, and the works gave employment to twelve hundred persons. The annual value of the manufactured articles was estimated at 250,000 francs, of which Spain alone took to the amount of 180,000 francs, or £7,000. This is not surprising when we reflect that Spain, being a Roman Catholic country, rosaries are much in use; and that black being very general as a costume, black ornaments will be in great demand. Spain, also, sent out a great quantity to her colonies. At present, the demand is comparatively trifling.

Jet ornaments are cut with facets like stones; the operation is performed on horizontal wheels of sandstone, with water. In some cases the wearing down

of the facets is done on one stone and the polishing on another, but sometimes both operations are performed upon the same stone by the same workman; the outer portion of the stone being rough, and the part nearer the centre smooth for the polishing. The operation is very expeditious. Favrot informs us, that when the manufactories of St. Colombe were in full activity, a good workman could shape from 1,500 to 3,000 beads in a day, according to their size; and he who had to pierce them could drill from 3,000 to 6,000 holes, and the polisher could finish 10,500 facets a-day.

In this country, Jet is hardly used but as mourning ornaments; rings and chains made of it are extremely brittle, and I have known beads worn round the neck to exfoliate after a time; their polish also loses its brilliancy. You must not confound the substance I am speaking of with artificial Jet, which is so abundant in the shops. This latter is a vitreous composition of a fine black, and with a beautiful polish, which it preserves well. This artificial production is much heavier in the wear than real Jet.

Occasionally very fine pieces of Jet are thrown upon our coast. I have myself a fine specimen picked up near Ramsgate.

Fibrous Lignite, called also *Brown Coal*, *Wood-Coal*, and *Bituminous Wood*, appears to have but little analogy with common Coal. It occurs massive, and brown of various shades, and brownish-black; the latter, according to Phillips, is called *Moor-Coal;* (it must not however be confounded with the ebony-coloured wood, chiefly oak, found in bogs, and which, though changed in colour, is still perfect wood). The

fracture of the more compact kinds is sometimes conchoidal, and has a resinous lustre; that of other kinds is either earthy or splintery; some specimens cannot, from their external appearance, be distinguished from wood; these are called *Wood-Coal.* These fibrous lignites are more easy to break than wood; they may be cut with a knife, and have in some cases a shining streak. They burn with a weak flame and peaty smell: on being analysed, they are found to yield an acidulous and bituminous water, a thick brown oily bitumen, mixed gases and charcoal, as also lime, silica, and iron.

Brown Coal, in some cases, is so little changed as rather to belong to the vegetable than the mineral kingdom; but then, again, it passes imperceptibly into substances in which the mineral character predominates. It is very abundant, as compared with Jet, and in some places, as near Vitry, on the banks of the Seine, there is a thick bed of it, presenting whole trunks of trees well preserved. The island of Chaton, in the environs of Paris, is said to be entirely formed of it. In Liguria it occurs in extensive and thick beds, as also in Hanover. In England it exists in Lincolnshire, at the mouth of the Ouse; in Sussex, and particularly at Bovey Tracey, in Devonshire, whence it is called *Bovey Coal.* In Iceland it is very common, and is there called *Suterbrand.* The vegetable physiognomy is admirably preserved in some of the Bovey coal. I myself possess a few very beautifully characterized specimens, for which I am indebted to the kindness of M. Golding.

Wherever this lignite is in sufficient abundance it is used as fuel; but in some cases it retains so per-

fectly its character of wood, as at Vitry, already mentioned, that Mr. Michaut, of that place, has employed it for all the wood-work of his habitation; and a similar circumstance is recorded in Yorkshire.

Earthy Lignite is black or blackish brown, with a fine grained earthy aspect and fracture; it is friable, sometimes pulverulent, soft to the feel, shining in the streak, nearly as light as water, and burns with an odour generally disagreeable, but sometimes the reverse. It occasionally exhibits the woody texture.

It occurs in secondary rocks in the neighbourhood of coal, but more frequently in alluvial formations.

In the environs of Cologne it exists in very extensive and thick beds, among which are found fossil vegetables, as trunks of trees, both of the dicotyledonous and the palm species. This Lignite is moistened and moulded into conical lumps for their more easy transport. It is extensively used as fuel, and its ash is considered so valuable a manure, that much of it is burnt upon the spot for that purpose.

This Earthy Lignite is, moreover, employed for painting in distemper and even in oil-painting. The Dutch are said to use it in the adulteration of snuff, which it is considered really to improve, without having any pernicious quality. It is sometimes, though improperly, called *Umber;* but there is a very great deal of confusion about this latter substance. I possess some pulverulent Earthy Lignite, and which is of excellent quality and colour, that was found by a much-valued friend of mine, now no more, in a ravine near Grodno, accompanied by a brown bitu-

minous shale, easily cut when fresh, and which, when dry, exfoliates in thin plates.

Having thus given you some little information on a few of the bituminous Minerals, I shall say a word on Bitumen itself.

Bitumen is the generic name given to a class of highly inflammable minerals, differing in consistency from a thin fluid to a solid; though they are all rendered liquid by heat. The different kinds have received specific names.

Naphtha is perfectly fluid and diaphanous, with a yellowish tinge and a strong smell, somewhat analagous to oil of turpentine. Its specific gravity being only 0·80, it floats upon water. It is so extremely inflammable as to take fire on the mere approach of a candle, without actual contact. It burns with a bluish flame, gives out a thick smoke, and leaves no residuum. Naphtha is the most rare of the Bitumens, though it exists in considerable quantities in different places. Naturally, it is rarely pure, and has therefore to be distilled before it can be used in medicine, for burning in lamps, &c.

It occurs on the shores of the Caspian Sea, in the Caucasus, Japan, Persia, France, Sicily, and Italy; also in America. At Bakou, on the Caspian, it flows like springs, or is collected in wells of about thirty feet deep. In one locality as much as 500 pounds weight is collected daily; and from the whole of what is obtained in his dominions, the Khan of Bakou derives a revenue of 200,000 francs, about £8333. It is distilled in order to obtain the pure Naphtha, and the residue, which is black, is used by the Persians in place of oil for their lamps.

Near the Naphtha sources highly inflammable gas is abundantly given out from the soil; this the inhabitants collect, and direct by means of earthen tubes, and setting fire to it, use it for the burning of lime and for culinary and other domestic purposes.

The Guebres, Parsees, or Fire-worshippers, of whom there are still some left, and whose persecution by the Mohammedans has furnished Moore with the subject of one of his most beautiful poems, entertain the perpetual fire, which they venerate (not, it is asserted, as the Divinity, but in memory of their great legislator Zoroaster, who miraculously saved himself from being destroyed by that element), by merely lighting the gas at the end of a reed stuck into the ground.

The uses of Naphtha are not very extensive. Under the name of *Moum*, it is collected in a cavern near Darab, from the walls of which it exudes. The governor causes the cavern to be opened once a year, and the Moum collected is sent to the court of the Shah, it being regarded as a miraculous balm.

In 1802, Naphtha of an amber colour, which burns freely and without residue, was discovered near the village of Amiano, in the State of Parma, and being found sufficiently abundant, that village and the city of Genoa are illuminated with it. Naphtha was formerly used as a vermifuge; but if we except Asia, and particularly Persia, it is not now in any repute as a medicine. It is said to enter into the composition of that beautiful Chinese varnish which we call *Lacker*. Of late, attempts have been made to introduce purified Naphtha for lamps; but the most

important purpose to which it is now applied is as a solvent for caoutchouc.

Petroleum differs from Naphtha only in consistency and colour; it is thicker and more viscous than Naphtha, and of a reddish or blackish brown, almost opaque; its smell is stronger than that of Naphtha, so strong indeed, that at the bottom of some of the wells where it is collected, the workmen cannot remain above half an hour without being in danger of suffocation; its flame and smoke are the same as those of Naphtha, but on being burnt it leaves a little residue.

When Naphtha is exposed to light and air, it thickens and passes gradually into Petroleum; and as there are many circumstances in nature which may favour this change, it is no wonder that Petroleum should be more abundant than Naphtha. It is accordingly found in a great many places, as in France, at Gabian, (whence it is called Oil of Gabian); in Auvergne, at Seyssel, and other places; in Bavaria, Switzerland, Italy, Sicily, the salt-mines of Transylvania, in Galicia, Moldavia, &c. In England, it occurs at Ormskirk in Lancashire; Pitchford and Madeley in Shropshire, and in the tin-mines of Cornwall. In Scotland, at St. Catharine's Well, near Edinburgh; and in Pomona, one of the Orkneys. In Asia, on the borders of the Caspian, in Siberia, and in the Altaï Mountains. Along the Tigris it is so abundant as sometimes to cover the surface of the river, and travellers occasionally set fire to it for amusement. The boats which navigate the Tigris and Euphrates are payed with this substance. The principal fountains are at Kerkook, Men-

dali, and Badkee, at which latter place the wells seem to be inexhaustible; they fill again as soon as they are emptied: and Kinnier says some of them yield from 1000 to 1,500 pounds a-day.

Petroleum is also found in Japan, and in the kingdom of Ava, where there are about 500 pits sunk through the soil for obtaining this bitumen, which flows there from coal. The annual quantity obtained is said to be 400,000 hogsheads. The United States, Newfoundland, and Trinidad, also possess Petroleum, and it occurs in the Atlas Mountains, in Africa.

The extraction is effected in various ways, according to the state in which it occurs. Sometimes it is found floating on water, in which case it is skimmed off, or the two are taken up together, and the Petroleum subsequently decanted. When fluid, and alone, it is collected in the conical bottoms of wells or pits, sunk on purpose, and then taken up in buckets, more or less frequently as the source is more or less abundant. When mixed with the soil, as is the case at Seyssel, the sand containing it is collected and boiled with water in large caldrons; the Petroleum floating on the water is subsequently separated from it.

In many places it is employed in lieu of oil, for lighting streets, churches, and private houses, and mixed with earth, it is used as fuel. It is likewise used as a coating for wood-work, and indeed may serve for all the purposes for which tar is employed. It is called by the Chinese *Stone-oil*, and in Corea is used in the making of ink.

In some of the walls and edifices of ancient

Babylon the baked bricks were cemented together, it is said, with Petroleum; it is, however, probable that the cement used was a compact bitumen, which is soft when heated, but again becomes hard. Nevertheless, Petroleum at the present day is used in France for masonry under water.

Maltha, or *Mineral-pitch*, seems to be nothing more than Petroleum in a still more inspissated state; it is blacker, and leaves a more abundant residuum after burning. Its uses are much the same as those of Petroleum, to which we may add, that it is employed in the preparation of black sealing-wax.—It is found in the same localities as Petroleum, though it is more peculiar perhaps to the department of Puy de Dôme, in France, where it covers the soil with a viscous varnish that sticks to the feet of the traveller.

The substance already mentioned under the article *Naphtha*, as found in the Cavern of Darab, is by some referred to this sub-variety. Indeed, all these bitumens so pass into one another, that it is almost impossible to distinguish them, nor would I have endeavoured to specify them to you, were it not that having different names, you might suppose them more distinct than they really are.

I will merely add respecting Mineral Pitch, that it was regarded by the ancients as an efficacious remedy in cases of wounds; and there is no reason to doubt this, for it may be used to keep together the severed parts, to keep out the air, and may perhaps act as a balm.

By some, the name *Maltha*, or *Sea-wax*, has been given to a white substance not unlike tallow, which melts when heated, and on cooling assumes

the appearance of Cerate. It is found on the surface of the lake Baïkal, in Siberia, and at the foot of the Bakhtiari mountains, in Persia. This I apprehend to be either the mineral called *Hatchetine*, found at Merthyr Tydvil, in Wales, or something very analogous to it.

ASPHALTE, or *Bitumen of Judæa*, is still more compact and impure than any of the preceding varieties of Bitumen. It is black, opaque, or translucent only on the edges, solid, compact, friable, heavier than water, and leaves a residuum of 15 per cent. after combustion; its fracture is either perfectly conchoidal and shining, or hackly and dull.

It is found floating on the surface of the Dead Sea, called also the Asphaltite Lake, or cast up in pieces on its shores, where the people collect it for sale. This kind has evidently flowed from sources into the lake, and has become concrete by exposure.

Asphalte occurs also in Albania, in the Palatinate, and in the Hartz Mountains. In the Island of Trinidad there is a lake three miles in circumference, covered with it; but the locality best known to us is the Val de Travers, in Neufchatel, in Switzerland, where it is intimately blended with calcareous matter, forming solid blocks or irregular masses, of which the whole mountain whence it is quarried consists. It was first discovered in this locality, applied to some useful purposes, and recommended for others, by an ingenious, learned, and speculative Greek, named Eirinis, in 1712; but was not much noticed till 1838, when the Count de Sassenay, who had been the proprietor of the Petroleum deposits of Seyssel since 1832, became also proprietor of that

of Val de Travers. Since 1832, the produce of Seyssel, and since 1838, that of Val de Travers, have been in considerable demand in France, and have been partially used in England. The produce of both the Swiss localities is, I believe, called alike "*The Asphalte of Seyssel.*" It is chiefly employed, mixed with sand, as an artificial paving material in place of flags; for which purpose it is broken up, melted in a cauldron, stirred up and mixed with such other ingredients as are deemed necessary for the particular uses to which it is to be applied; it is then either spread at once on a proper substratum, or is moulded into blocks or slabs. When the Asphalt of Val de Travers is used, and prepared, and laid down by persons who thoroughly understand the work, it answers well, is durable, and comparatively cheap; but a great deal of very bad work has been done by rival speculators.

Asphalte has been called *Mummy-balm*, or *Funeral-balm*, from its being presumed to have served for the embalming of the Egyptian dead. But, for reasons which it would be too long to detail here, it is suspected that Petroleum, and even Naphtha, and a fluid bitumen called *Cedria*, have all shared in the honour of preserving the mortal remains of Sesostris and the other Pharaohs.

Klaproth says, Asphaltum is considered to have been the principal ingredient in the celebrated Greek Fire.

Elastic Bitumen, or *Mineral Caoutchouc.*—This curious substance is of a blackish or reddish brown; it is soft and elastic, particularly when warm. It removes the traces of Graphite like the vegetable

caoutchouc, but somewhat soils the paper. It is of about the same specific gravity as water, has a very strong bituminous smell, especially when soft. It burns with a bright flame, and leaves very little residue.

It is found at Castletown, in Derbyshire, and is said to occur also at Neufchatel, and in the Island of Zante. Its history is doubtful: it is not applied to any particular use, is found only in small quantity, and is no otherwise interesting than from its resemblance to the vegetable production of the same name.

Retinasphalt is a bituminous substance, which is found in irregular opaque masses, of a pale brownish-yellow colour, having an imperfect conchoidal fracture, sometimes an earthy and sometimes a hard resinous texture; it is brittle and soft, melts when placed on a hot iron, smokes and burns with a bright flame, emitting a fragrant odour. It is found at Bovey Tracey, in Devonshire, along with the brown coal, and also at Walchow, in Moravia, and one or two other places.

There are other bituminous substances than those which I have mentioned; but they are found in very small quantities, and are not of much interest; besides, you will remember, my pretty Cousin, I by no means undertook in this correspondence to treat of every known mineral. There is one, however, which might perhaps have found its proper place in this letter; it is *Amber*—but I prefer treating of this, together with *Coral* and *Pearls*, in a separate communication devoted to such peculiar substances. *Peat* is also included by some mineralogists in their

treatises; but it is a substance which, though highly interesting, is too evidently vegetable, too seldom mineralized in the true sense of that word, for me to notice it among the minerals to which I would direct your attention; unless you particularly wish it, when I may give you some account of it in a separate letter.

LETTER XXIV.

Platinum—Gold.

As you have expressed the desire, my inquisitive Cousin, that I would give you some information respecting Peat,—more particularly, say you, because it is your intention next Spring to spend a few days with a family, in a part of whose estate it is dug and used in considerable quantity,—I will endeavour to satisfy your laudable curiosity, provided you promise me not to frighten with your wonderful knowledge the simple and honest people who have all their lives been using Peat, without knowing more about that production than the uses to which they apply it; and who think it quite sufficient to thank God for the blessing of a cheap and abundant fuel, without troubling their heads about its history. As we have, however, plenty of time, I shall for the present postpone the subject of Peat, in order to enter upon that of a most important group of minerals, the metals.

The Metals constitute the most numerous class of the simple, or at least hitherto undecomposed, bodies. Of these, the ancients were acquainted with only seven, but the discoveries of modern science have extended that number to nearly seven times as many.

The following are the general characters by which the metals are distinguished. 1. They possess a peculiar lustre, which is the same, or even brighter, in the

streak and in the smaller fragments. 2. They are fusible by heat, and in fusion retain their lustre and opacity. 3. They are all, except one, (Selenium), good conductors both of electricity and caloric. 4. Many of them may be extended under the hammer, and are called *malleable* ; or, under the rolling-press, and are called *laminable* ; or drawn into wire, and are called *ductile*. 5. When their saline combinations are electrized, the metals separate at the negative pole. 6. When exposed to the action of oxygen, chlorine, or iodine, at an elevated temperature, they generally take fire, and combining with one or other of these elementary dissolvents in definite proportions, are converted into earthy, or saline-looking bodies devoid of metallic lustre and ductility, called *oxides*, *chlorides*, or *iodides*. 7. They are capable of combining in the metallic state with each other, in almost any proportion, constituting alloys. 8. Most of them combine in definite proportions with sulphur and phosphorus, forming bodies frequently of a semi-metallic lustre; and others unite with hydrogen, carbon, and boron, giving rise to peculiar gaseous or solid compounds.

The present list of metals is as follows:—

1 Platinum.	11 Cadmium.
2 Gold.	12 Zinc.
3 Silver.	13 Bismuth.
4 Palladium.	14 Antimony.
5 Mercury.	15 Manganese.
6 Copper.	16 Cobalt.
7 Iron.	17 Tellurium.
8 Tin.	18 Arsenic.
9 Lead.	19 Chromium.
10 Nickel.	20 Molybdenum.

21 Tungsten.	33 Calcium.
22 Columbium.	34 Barium.
23 Selenium.	35 Strontium.
24 Osmium.	36 Magnesium.
25 Rhodium.	37 Yttrium.
26 Iridium.	38 Glacinum.
27 Uranium.	39 Aluminium.
28 Titanium.	40 Zirconium.
29 Cerium.	41 Silicium.
30 Potassium.	42 Thoricum.
31 Sodium.	43 Vanadium.
32 Lithium.	

Of these, the first 12 are malleable, and so are the 30th, 31st, and 32d, in their congealed state. The first 16 yield oxydes, which are neutral, salifiable bases. The metals 17 to 23 inclusive, are acidifiable by combination with oxygen. Of the rest up to the 30th, little is known. The remaining metals form with oxygen the alkaline and earthy bases. (A reference to my earlier letters will assist you in the understanding of these terms.)

Numbers 2, 3, 5, 6, 7, 8, and 9, were, till of late years, the only known metals, and they are, indeed, together with Nos. 1, 10, 12, 13, 14, 15, 16, and 18, the most important, and the only ones of which I shall speak. The whole of the metals have been divided and arranged in lists, according to their colour, their specific gravity, malleability, laminability, ductility, brittleness, dilatability, fusibility, affinity for oxygen, and other physical and chemical properties: but these arrangements belong rather to chemistry than mineralogy, and are, moreover, foreign to the object of these letters, which is merely to supply you with a few of the more positive facts relating

to those substances that are most generally met with and are most useful.

PLATINUM, or *White Gold*, as it has been called, was discovered, according to some, by Don Antonio de Ulloa, in 1735; others say by Wood, in 1741. It derives its name from the Spanish *Plata*, silver, on account of its silvery aspect. Its colour is a very light steel-grey approaching to silver-white. It occurs in little flat grains or larger pieces called *pepites*. It is nearly as hard as iron, and is both malleable and ductile. It is never met with pure, being alloyed with about 20 per cent. of other substances, particularly iron, also rhodium, iridium, osmium, palladium, and copper, and sometimes a minute portion of gold. Some authors, as Thenard, add to these, lead and sulphur, and Brongniart mentions chrome. Phillips says the primary form of Platinum is the cube; but it very rarely exhibits traces of crystallization. It requires such an intense heat to melt it, that it may almost be considered infusible, and is soluble only in nitro-muriatic acid. It takes a fine polish, and does not tarnish nor rust; but when artificially oxydised by heat, its oxyde is brown, and its precipitated oxydes from acid solutions are yellow or greenish. It is the heaviest of the metals, and its specific gravity, as given by different authors, is from 15·60 to 20·98, and when purified 23·0.

Its original repositories are unknown, having hitherto been found only in certain alluvial deposits, together with gold, magnetic iron, and gems. It was first obtained from the provinces of Choco and Barbacoas, in South America; from Matto Grosso, in Brazil; and from St. Domingo; but, in 1822, it was

discovered in the Ural Mountains, where it was first worked for in 1824. Since then the greater quantity has been supplied by Russia.

Vauquelin is said to have discovered Platinum to the amount of 10 per cent. in the argentiferous copper-ore of Guadalcanal, in Spain.

The Russian mines have furnished some *pepites* of large size. There is said to be one. at Madrid, in the Museum, of 4 inches by 2½, weighing 1 lb. 9 oz.; it was found at Condotto, in South America, and Humboldt presented one to the King of Prussia, weighing 2 oz. and half a gros; but these are nothing to what have been since found in the Ural Mountains, one pepite from which locality weighs 14 lbs.

You will readily have gleaned, from what precedes, that Platinum must be a most useful metal, and so it really is. Its refractory and unalterable nature, even when exposed to intense heat, and its not being acted upon by salts and acids, fit it in a very peculiar manner for chemical purposes, and accordingly crucibles and caldrons, sometimes of very large size, are made of it. Its polish and freedom from rust and tarnish, its slight dilatability, and the regularity of its expansion for equal increments of heat, render it very valuable for pendulums, watch-wheels, pyrometers, and measures. Thus the rods used in measuring an arc of the meridian between Dunkirk and Barcelona were of Platinum, and the standard-yard, metre, and other measures of different countries, are made of it. For reflecting telescopes and mirrors it is excellent, from its not tarnishing and its giving but a single image. Glass, as you

know, or may easily see by applying the head of a pin to your mirror, gives a double image, caused by the reflexion from its two surfaces, and this double reflexion is very prejudicial for astronomical purposes. Other metals, or rather alloys of metal, have been, and are still, used for specula, but they are all liable to tarnish and rust. Prepared with arsenic, Platina is applied to porcelain, to which it gives the appearance of polished steel. As it may be used for covering other metals to preserve them from rust, it is very valuable for coating the extremities of lightning conductors. The pans of the locks of fowling-pieces and the touch-holes are now of Platinum; they were formerly of gold. It has been proposed to coat our culinary vessels of copper with Platinum instead of tin. Platinum is not sufficiently brilliant to be used for ornamental jewellery, and those watch-chains and other objects that have been made of it are more curious than pretty.

To the assayer and analytical mineralogist Platinum in the shape of fine wire, thin foil, forceps, &c. is extremely valuable. As Platinum forms alloys with almost all the other metals, it has been dangerous in the case of gold coin, which may contain 48 per cent. of it without the yellow colour of the gold being affected. *En revanche* for this evil, Platinum supplies the surgeon with a most invaluable substitute for the silver plates hitherto used by him, and which were attended with great inconvenience. Finally, not only have medals been struck of Platinum, but, in Russia, it was introduced as a current coin; specimens of which I will some day shew you. They have, however, been called in, as the people did

not like them, and took them unwillingly. Besides which, the great quantity of Platinum now found in Siberia, has considerably lowered its value for the purposes of coin. From 1831 to 1833 the Russian mines produced nearly 14,000 lbs. weight of Platinum.

I cannot possibly enter into an enumeration of all the uses to which Platinum is applied, but I must not conclude this short account of this interesting metal without giving you the following from Brard:

"If," he says, "you take a phial of alcohol and put a cotton wick into it, as for an ordinary spirit lamp, and then surround this wick with a spiral coil of Platinum wire, so that it may project, this wire will become red-hot as soon as the wick is ignited, and when this is put out with an extinguisher, the Platinum will continue red-hot, as long as any spirit of wine remains in the phial; so that a phosphorus match applied to it will give an instantaneous light. When you would put out this singular metallic wick, you have only to blow hard upon it." The late improvements, however, in instantaneous-light matches have nullified the utility of this invention. You may probably have seen another kind of instantaneous-light apparatus, founded also on a peculiar property of Platinum. When this metal is prepared in a particular way, it is called spungy Platinum, and, in that state, becomes red-hot when a jet of hydrogen gas is made to impinge upon it. A bottle is accordingly prepared, in which water and sulphuric acid are placed with a piece of zinc. The water is thus decomposed, and its hydrogen, set at liberty, fills all that part of the vessel in which there is no water.

On touching a spring, this gas is allowed to escape, and a pointed nozzle directs it against a small portion of spungy Platinum, fixed on a support at a small distance from the extremity of the nozzle; the Platinum becomes red-hot, and, in its turn, sets fire to the jet of gas; and from this flame a taper may be lighted.

The next metal of which I shall speak to you, my dear Florence, is that which, known in the earliest times as in our own, has made us pay so dearly for the advantages it procures by the crimes it has occasioned—I allude to Gold.

Gold is almost universally esteemed the chief good. The egotist covets it for himself; the philanthropist desires the possession of it for the benevolent purposes to which he would apply it. Rightly employed, it is a source of comfort and of allowable gratification to ourselves, and of relief to others; as its abuse is the bane of society, and the great enemy of virtue.

When we contemplate the thousand ills that wait on poverty, we sympathise with suffering humanity; and seeing how many and keen misfortunes may be relieved, how much injustice may be redressed by means of money, we join with the compassionate who sigh for wealth and covet Gold.

But setting aside its charitable uses, money confers many and important benefits. Without Gold, science and industry would languish, and with them all that contributes to the comfort and charms of our material existence. On the other hand, Gold is the perennial spring of evil, the corrupter of innocence, the oppressor of virtue, the shield of vice. The keen

sword of justice falls blunted against a buckler of Gold. Great wealth gives almost unlimited power, and as we wish the end, we strive to obtain the means. Christopher Columbus, in his last letter to King Ferdinand, says, "Gold is a thing so much the more necessary to your Majesty, because in order to fulfil the ancient prediction, Jerusalem is to be rebuilt by a prince of the Spanish Monarchy. Gold is the most excellent of metals. What becomes of those precious stones which are sought for at the extremities of the globe? they are sold, and finally converted into Gold. With Gold we not only do whatever we please in this world, but we can even employ it to snatch souls from purgatory and to people Paradise." But woe to the conquerors of the New World! the Temple of Jerusalem has not been rebuilt with the gold of Peru; and much do we fear that neither the re-construction of that edifice, nor all the masses Gold might purchase, would atone for the cruelties of the conquest. No! Shades of Guatimosin, of Atahualpa, and of Montezuma, rest in peace! the terrible hour of retribution must arrive, when your ruthless assassins will receive the reward of their crimes, and an account be demanded of them for the horrors they have perpetrated, and for the innocent blood with which they deluged your unhappy country. Really when we reflect on all the misery that has been caused by Gold, we are tempted to exclaim—Execrable Gold! why did you not for ever hide your treacherous splendour, your dazzling brightness, from the eager gaze of man? Beneficent nature had concealed you in the mass of the mountains; but you have come to the light of day, and,

borne along by the waters, have surrendered yourself to the rapacity of man to fill up the measure of his woes.—But I must quit this strain.

Gold was known in the earliest times. The mummies of Egypt are adorned with it, and we possess medals and objects of Gold of the highest antiquity. We may presume, indeed, that this metal, in the state of powder or grains, formed part of the treasure of princes long before men had learnt the art of working it.

In the days of Solomon it was very abundant. This king, as gallant as he was wise, and who finished (as most men do sooner or later, who have all they can wish for,) by discovering that all is vanity, had, as you know, seven hundred wives and three hundred concubines. Now, judging by what it costs a duke to satisfy the caprices of one duchess, I presume the maintenance of so many ladies, wives, and attendants of a powerful king, must have been somewhat expensive. Indeed, we are informed that the good king received annually 666 talents of Gold, not much less than £4,000,000, without reckoning the little presents which were every now and then sent to him by the kings his tributaries. We read in the Bible that all his utensils were of Gold, which was nothing accounted of in those days.

Diodorus assures us that the tomb of a certain king, Asmandias, was surrounded by a circle of Gold of three hundred and fifteen cubits, and one cubit high.

The statues and cratera of Gold, presented by Gyges, king of Lydia, and by Crœsus, to the Temple of Apollo, were valued at nearly £1,000,000.

Semiramis erected at Babylon three statues of Gold, one of which was forty feet high, and weighed 100 talents: these statues had a golden altar, forty feet long, and twelve wide.

We are also told, that the treasures collected by the kings of Persia were enormous, and that Alexander, having conquered that empire, drew from it annually to the amount of £67,500,000: probably this was not all gold, though no doubt there was a great quantity of this metal.

Under the palace of Kosroe Parvis there were one hundred vaults filled with treasure, of which a great proportion was gold.

Now admitting these statements to be greatly exaggerated, it still shews that notwithstanding the seeming scarcity of Gold, nature has furnished it with no scanty hand. Greece, Lydia, Africa, and India, were the countries whence it was anciently procured.

When Mahmoud, prince of Guzne, conquered that country, in the beginning of the eleventh century, he carried off immense treasures, displaying, on his return, among other riches, several thrones of Gold; and such was his magnificence, that in his hunting establishment there were four hundred greyhounds, each of which had a collar of gold enriched with precious stones. Much later, and almost in our own time, Nadir Shah carried away treasures from India, the amount of which seems almost fabulous, and a great portion of which was Gold.

If from the Old world we pass into the New, we find the Temple of the Sun, the Palaces of the Incas, the habitations of the chiefs, and even of the people,

resplendent with Gold. The Peruvians and the Mexicans employed this precious metal in many cases where we use iron. The quantity carried away by the Spaniards astonishes even the imagination. On one single occasion, François de Bovilla loaded with it twenty-one vessels, which all foundered in sight of the port whence they had sailed.

From a calculation made some years ago, it appeared that the American mines furnished annually about £2,500,000 worth of Gold, of which the Brazils alone supplied about £1,000,000; Africa, at the same epoch, furnished £215,375; Europe, £100,000; and Asia, £250,000; making together upwards of £3,000,000. But this amount is now nearly doubled, for Russia, whose mines furnished comparatively little, supplied for her own share, in 1844, no less than £3,000,000! while the researches that have been made along the foot of her mountain-chains in Asia, prove the existence of still richer and more extensive deposits of Gold than any of those already worked!

Gold is chiefly found in alluvial deposits, sometimes in veins disseminated in Quartz, and sometimes in the mass of the rocks. It is sometimes pure, and sometimes mixed with other metals. Berthollet has proved the existence of Gold in vegetables, having extracted forty grains of this metal from a hundred-weight of ashes, of a common plant, whose name I forget. It is said also to have been found in the stalks of the vine. On this subject, I give you the following, without vouching for its accuracy:—In the *Journal des Savans* for March 1723, it is stated that "Father Kircher (Jesuit), and other persons

worthy of belief, assert, that in the vines that grow above the Gold-mines of Tokay, one often finds gold which has grown with the plant, and that it is in the state of filaments, in the stalks of the vine."

Several authors assure us that Gold and other metals vegetate in the manner of plants. Thus, M. Crosset de la Haunerie says, "that in many places branches of Gold may be seen growing out of the soil;" and he adds, that he has read that "the King of Ethiopia had sent to the King of Mogul a shrub of Gold, very pure, and one foot in height." There is no doubt that Gold, as well as native Silver, and native Copper, occasionally occurs in the form of branches and filaments resembling vegetation; and in some cases, the matrix in which it was so formed may have been worn away, leaving the ramose Gold isolated.

Gold, as a money, or circulating medium, offers incalculable advantages for commerce; it possesses every quality requisite for coin. 1. It has a value which may be considered invariable. 2. A direct value, but which is limited by factitious wants. 3. An invariable quality. 4. A limited production, (for, notwithstanding the great deposits of which I have spoken, a time must come when they will be exhausted). 5. A durable and unalterable nature. 6. Facility of subdivision. 7. Is of easy transport. 8. Is easily distinguished from any other substance, and its genuineness easily tested. 9. Is susceptible of receiving an impression certifying its purity and weight: in a word, its value. Now no metal wanting any of these qualities will do for coin, and no other (platinum excepted), possesses them in an

equally eminent degree; hence it has been chosen as coin, and standard of value.

The beautiful colour of Gold, and the splendid polish it is capable of receiving, have caused it to be largely employed for dress and decoration. But objects of pure Gold are not only too expensive, but are too soft to retain their shape; and hence, in Europe at least, it is usually alloyed with some other metal, chiefly copper.

Fortunately for luxury, a peculiar property of Gold enables us to cover with it all sorts of substances, which thus acquire, externally, all the brilliancy of the metal itself. Silver, Copper, Iron, Stone, Porcelain, Glass, Wood, Ivory, Silk, may all be invested with the dazzling robe of this king of the metals.

Such is the ductility of this noble metal, that it may be reduced into leaves or pellicles so extremely thin that 14,000,000 of them only make one inch in thickness; whereas that same number of sheets of paper, such as that this is written upon, would make a thickness of 47,520 inches, or three-quarters of a mile. One ounce of Gold is sufficient to gild a silver wire 520 French leagues, or about a thousand miles long; and further, this same ounce of Gold will furnish fourteen billions of particles visible to the naked eye. The pretty Venetian chain you wear round your neck, is sufficient to gild half a million similar chains, every one of which would, for a time, be equally brilliant with it.

This extreme ductility of Gold admits of our giving to it any form we please, and the facility with which it alloys with other metals enables the artist

to change its colour as he pleases. Thus Silver, according to the proportion in which it is used, gives to Gold a greenish or whitish colour; iron renders it bluish; copper reddens it, &c.

Gold in a state of fusion is green; and while a thin leaf of this metal is yellow by reflected light, it appears green if held between the eye and the sun. Its oxide, when obtained by electric fire, is purple. Precipitated from its only solvent, nitro-muriatic acid, by tin, it forms that fine colour known as *Powder*, or *Purple of Cassius*. The glass of old Gothic windows owes to gold its bright red; a colour which was formerly given to drinking-glasses and similar objects, and which the moderns have not yet completely succeeded in imitating. On the Porcelain vase, the king of the metals becomes the queen of the flowers; roses being painted on China-ware with Gold. Moreover, with the beauty of Apollo Gold is as terrible as Jupiter. In order to understand which, you must know that the alchemists called Gold *Sol*, or the Sun, or Apollo; and from this metal a fulminating powder is obtained, which struck blind a friend of M. Baumé's, as we are informed by Macquer.

Gold, I have said, is usually found in alluvial soils, but is sometimes met with disseminated in rocks. It is susceptible of crystallization, and the forms of its crystals are the cube, the regular octahedron, and several of their varieties. It is sometimes, as when in a gangue, found in the form of leaves, ramified and capillary. In what are called the gold-sands, it is in very fine grains; but occasionally large pieces are met with. Thus several heavy

pepites have been found in the Siberian mines; one was found in 1842 weighing 87 lbs. The Gold is obtained by washing the sand; the metal, from its great weight, subsides, while the impurities are carried away.

Gold exists in Wicklow in Ireland, and no doubt also in Scotland, if it be true that the ancient kings of Caledonia had vessels of Gold, the produce of the country. It may probably exist in the sand of many rivers little suspected of containing it.

I shall now conclude this letter by observing to you, that, if all countries are not equally rich in the possession of Gold, there is a sort of compensation. The more Gold there is in a country, the less is its relative value, and accordingly, so much the more of it must be exchanged for other objects; and, on the other hand, the less money there is, the higher is its value. In countries where living is what we call dear, money is abundant, and where money is scarce, living is cheap.

I could easily shew you that it would be a great misfortune for any country which should possess Gold enough to obtain from other countries all it might want; but all these considerations are foreign to mineralogy; they belong to the science of political economy; and as I know that my good little Cousin prefers domestic economy, the true science of her sex, and that, provided she has always money enough to carry into effect the generous inspirations of her benevolence, she would willingly leave to statesmen the task of examining the causes of the wealth or poverty of nations, I shall say no more on this topic. But in showing you that Gold, besides

its intrinsic value, has also a relative value, depending on its abundance or scarcity, you will be the more struck with the folly of the alchemists. So soon as they succeeded in the transmutation of metals, the changing of lead into Gold, this latter would have lost its value, and mankind would have been compelled to seek from nature some other substance which she alone could produce, and that should in all respects replace Gold.

I now hope, dear Florence, that I have given you a sufficient notion of this precious metal, which, like all else in nature, is a blessing or a curse, according to the use we make of it. The generous and benevolent cannot have too much of it, for they employ it in fostering useful industry, in protecting the arts and encouraging science; and, above all, in relieving many of the distresses of their fellow-creatures. In a word, they do with their fortune what my dear Florence finds such happiness in doing, to the extent permitted by her means.

LETTER XXV.

Silver—Native Silver—Sulphuret of Silver—Ruby Silver—Quantity of Silver—Tree of Diana—Mercury—Native Mercury—Native Amalgam—Sulphuret of Mercury or Cinnabar.

WITHOUT any preface, my dear Florence, I shall go on with my account of the more important of the metals. After Platinum and Gold, I will take Silver, merely observing, that I have no very particular reason for adopting any order in preference to another; these letters having no pretension, as I have before reminded you, to be regarded as a systematic treatise.

SILVER is a metal whose external aspect is so well known, as hardly to need any description. In its pure state it is remarkably white and brilliant, it is very malleable, flexible, and ductile, and soft enough to be cut with the knife. Its specific gravity is from 10·00 to 10·47. It is not susceptible of oxidation by simple contact with the air, but it tarnishes. When oxidized, it is again easily reduced to the metallic state, by the action of the blow-pipe and a combustible body. Its oxide communicates an olive-green colour to glass. Silver is soluble in cold nitric acid and heated sulphuric acid.

As the alchemists called Gold SOL, so they gave to Silver the name of LUNA, or Diana.

Silver is found native, and combined with other substances, as Antimony, Arsenic, Sulphur, &c.

NATIVE SILVER is seldom quite pure, being frequently combined with a minute admixture of

Copper, Arsenic, Gold, &c., which renders it less malleable than the pure metal, obtained by metallurgical processes. It occurs crystallized, in the form of a cube, or a regular octahedron; also capillary, ramose, and reticulated; but a close inspection with the microscope will discover, says Phillips, that these varieties consist of a congeries of elongated crystals, or of minute cubes, or octahedrons, closely aggregated, and disposed perpendicularly in straight rows. Native silver seldom occurs massive, though rolled lumps of considerable size, have occasionally been found in Peru. It is harder than gold, tin, or lead; but softer than iron, platinum, or copper, and occurs principally in veins in primitive mountains, and transition rocks. In Europe, it is found in Norway, Saxony, Bohemia, Hungary, France, &c.; as also, in some of our Cornish mines. Jameson says £40,000 or £50,000 worth of Silver, part of which was native Silver, was obtained some years since, from a vein at Alva, in the county of Stirling.

In Norway, very large masses have been found: thus, Jameson tells us, that in the years 1628, 1630, 1666, 1695, and 1769, respectively, there were found lumps of native Silver of 68 lbs., 204½ lbs., 560 lbs., 118 lbs., and 500 lbs. In a mine near Freyberg, in Saxony, a mass of Silver of 168 lbs. was dug out, in 1750. At Schneeberg, in the same country, a rich vein of Silver was discovered in 1478; and so rich a block of the native metal and ore was dug out, that Duke Albert of Saxony descended into the mine, and used this block, (which when smelted produced 44,000 lbs. of Silver,) as a table to dine on. In France, lumps of native Silver, of upwards of

60 lbs. weight, have been found. In Asia, native Silver is met with in several parts of Siberia; also in Java, and in China. From this latter country a piece of native Silver was brought to St. Petersburg, of such purity, that some coin was struck from it without its passing through the crucible.

In North America, massive native Silver is said to be much less abundant than is generally supposed; nevertheless, some large pieces have been found; thus, in New Biscay one was discovered weighing 444 lbs.

In South America great masses of native Silver have occasionally been met with; thus, in 1758 and 1789, two pieces were discovered in the mines of Coronel, and of Loysa, the one weighing eight, the other two, quintals. In the plain called La Pampa de Navar, filaments of native Silver adhere to the roots of the grasses. Frequently, the Silver is found in masses, as if portions of this metal had been poured upon a very soft clay.

You must not imagine that native Silver, where it exists, is necessarily in lumps of greater or less size. It is often in minute, and almost imperceptible, grains or powder, like gold. Thus, the greater part of the Silver from Peru, and a certain quantity of that from Mexico, is obtained from an earthy mass, called in the former region *Pacos*, and in the latter *Colorados*, consisting of imperceptible grains of native Silver mixed with brown oxyde of iron. Pepites of native Silver are much more common in the European mines than in those of America.

There are a great many varieties and sub-varieties of Silver ore; some of these are very rich in

Silver, some moderately so, and some very poor; of these varieties, some are scarce and some abundant. I shall only mention one or two of the most important, or interesting.

Sulphuret of Silver.—This ore is of a dark, blackish, lead-grey; it generally occurs massive, sometimes disseminated, and in membranes; also, dentiform, filiform, capillary, reticulated, dendritic, stalactitic, &c., and crystallized in cubes or octahedrons. It is harder than gypsum, but not so hard as calcareous spar; it is flexible, but not elastic; completely malleable, but difficult to break. It is related by Berzelius, that the King of Poland, Augustus I., had some medals struck from pieces of Sulphuret of Silver, which were found in his reign in the Silver-mines of Saxony.—The specific gravity of this mineral is from 5·7 to 6·1. The flame of the blow-pipe drives off the sulphur, and leaves the Silver in a dendritic, or capillary form. It is a very rich ore, containing from 75 to 85 parts in the hundred of Silver. It is the most frequently met with of the ores of Silver, and occurs principally in veins in primitive and transition-rocks, where it is associated with other ores of Silver and other metals. There is a black, earthy, sub-variety of this ore, and a brittle variety; this latter, when crystallized, presents the form of a six-sided prism, a six-sided table, or a six-sided pyramid; is soft, sectile, and easily frangible. It is reducible before the blowpipe into a globule of imperfectly malleable Silver; and is somewhat less rich than the former, containing about 66·5 per cent. of Silver. It occurs in the Hartz, in Saxony, in Suabia, Austria, Bohemia,

Hungary, and Sardinia, and at Schlangenberg in Siberia. It is the most common of the ores of Silver in Guanaxuato, Zacatecas, and Real del Monte, in Mexico ; but is less abundant in Peru.

Red, or Ruby Silver.—This is a very beautiful ore, and is divided by mineralogists into two sub-varieties, the dark, and the light; the former being a compound of Sulphuret of Silver and Antimony, and the latter of Sulphuret of Silver and Arsenic. Both are rich in Silver; the former containing 58·94 parts in the hundred, and the latter 64·67. The specific gravity of the two differs; the dark red being somewhat the heavier. Their crystalline forms are, however, the same, and these are very various, and sometimes exceedingly complex. The primitive form is a rhomboid. It varies, says Phillips, by reflected light, from lead-grey to iron-black; by transmitted light, from brilliant to dark red; it is semi-transparent ; its lustre is semi-metallic in dark-coloured varieties, adamantine in such as are light; its streak presents different shades of cochineal-red; it is easily cut with the knife; is reduced to metallic Silver before the blow-pipe, and dissolves with effervescence in nitric acid.

This very interesting ore is met with in only a few localities; but in some of these it occurs in great abundance. Thus, Humboldt informs us, that the mine of Veta Negra, near Sombrerette, furnished, in a space of ninety-eight feet in length, a quantity of it, which, being smelted, yielded 700,000 marcs of Silver in five or six months; the greatest quantity of Silver ever obtained from one part of any mine. This Ruby Silver may sometimes be mistaken for

red orpiment, or for copper-glance; but the streak of the orpiment is yellow, and that of the copper, black; while that of the Silver, as I have said, is cochineal-red.

Lead-ore often contains so much Silver, as to be included among the ores of the more precious metal; it is called Argentiferous Galena. Of this kind there is a mine at Antrim, in Ireland, where every thirty pounds of lead ore produce one pound of Silver. Iron pyrites are also sometimes argentiferous, and a great deal of Silver is obtained from them in Mexico.

You are no doubt aware, that by far the greatest quantity of Silver comes from Peru and Mexico; more now from the latter than from the former locality. Would you have the most interesting details on the subject of these American mines, their number, particular locality, nature of their ores, and produce, I must refer you to Humboldt's *Essai Politique sur le Royaume de la Nouvelle Espagne.* He tells us in conclusion, that in the space of three centuries these mines have furnished the astounding quantity of 316,023,883 pounds troy of pure silver, which would form a solid globe of that metal, of more than ninety-one feet in diameter; and that the quantity of Gold and Silver imported into Europe between the years 1492 and 1803, is estimated at £1,666,775,322 sterling! The *annual* produce of Silver he gives as follows:—Europe, £468,177, Asia, £192,996, and America, £7,071,830.

This immense quantity of Silver, produced by the American mines, does not however result from any particular richness of the ores; some of those of

Europe are much richer; but it proceeds from their great abundance, and the facility of working them. Thus, while the ore of the Obergebirge gives from ten to fifteen ounces of Silver per quintal of ore, the American mines give, one with another, little more than three ounces per quintal. Humboldt says, that three millions of marcs of Silver, produced in a good year from the Mexican mines, are obtained from ten millions of quintals of ore, which would make about $2\frac{2}{5}$ ounces of Silver per quintal of ore.

Of all the Mexican repositories, the famous veins of Guanaxuato are the richest; these alone, since the end of the sixteenth century, have produced Silver to the amount of 1,400,000,000 livres Tournois.

The gigantic scale of the workings may be imagined from the fact, that in the mine of Valenciana, when Humboldt wrote, the expense for men, gunpowder, tools, &c., amounted *annually* to 4,500,000 livres Tournois.

There exists a native amalgam of Gold and Silver, in which the proportions of the two metals are different; that in which the Gold is the most abundant is called *Argentiferous Gold*, and that in which the Silver is in greatest quantity is called *Auriferous Silver*. This latter kind has been found in Norway, yielding 28 per cent. of Gold, and the former kind in Siberia, containing 64 per cent. of Gold and 36 of Silver.

Although Silver is not so ductile as Gold, it comes next in order of facility for drawing into wire; indeed, this latter may be made of such fineness, that a grain of Silver may be drawn out into a wire of four hundred feet long. It is also easily rolled out

into thin sheets, and may be beaten into leaves of the hundred-thousandth of an inch in thickness.

In the treatment of Silver it has been found that it is volatilized by heat; and hence the soot of the chimneys of workshops, where this metal is heated, is collected for the Silver it contains.

Silver is never used in a state of purity, either for coin, medals, plate, or statues, &c.; but is mixed with a proportion of copper, which, for English coin, is three parts of copper to thirty-seven of Silver; with regard to plate, the proportions vary.

The reason why copper is introduced, is to give greater hardness and durability. As it is, we find silver coin and plate to wear away quite fast enough; but, without the addition of copper, the loss would be very much greater.

The beauty and cleanliness of Silver render it particularly appropriate for the purposes to which it is applied, as plate for use, and as ornamental vases, epergnes, candelabra, statues, &c., in which the burnished parts contrast beautifully with those that are chased or deadened.

If a piece of silver be soldered to a piece of copper, the two may be beaten out together into any desirable form. This mode constitutes a very durable kind of plating. Ordinary plating, like gilding, may be effected by mercury; but other methods are employed. When mercury is used, it is mixed in a certain proportion with gold- or silver-leaf into a pasty mass; with this the object to be gilded or plated is rubbed over, the mercury is then driven off by heat, and a film of gold or silver remains, to which more of the precious metals may be added,

in the form of leaf, while the utensil or object is still hot, and is burnished down. This process, which is called water-gilding, or plating, is very injurious to the health of the workmen, by reason of the mercurial fumes, and hence the modern discovery of electro-gilding and plating is very important.

Silver dissolved in nitric acid forms the *Lunar Caustic* of the apothecaries ; it burns away the flesh when applied to it, and is employed in surgery.

The Nitrate of Silver dissolved is colourless, but is used to dye hair black, for staining marble, agates, &c. ; also for silvering ornamental work, as ivory &c. ; with gum-water and an alkali it is used as indelible ink for marking linen. Silver-leaf may be applied in the cold way to wood, leather, &c., like gold-leaf.

This beautiful metal, as I have said, is subject to tarnish by exposure ; it becomes dim, yellowish, and finally black. This is due to the sulphureous emanations from men and animals ; and in England, particularly, to the sulphureous vapour given out by our coal-fires. Silver is, however, easily cleaned with soap and water, and brightened by whitening, or by any of the known plate-powders. Silver prepared in a particular manner forms a violent and most dangerous fulminating powder.

You may sometimes have observed in the windows of apothecaries, and philosophical instrument-makers' shops, a pretty metallic vegetation in glass jars : one of these is called the *Tree of Diana*. It is thus obtained :—form an amalgam with four parts of silver-leaf and two of mercury, and dissolve this amalgam in diluted nitric acid ; then add water to

the solution, equal to thirty times the weight of the metals employed, and put the whole aside for use. If an ounce of this solution be at any time poured into a phial, and a small piece of soft amalgam of Silver be dropt in, filaments of reduced Silver will shoot from it, and extend upwards, in the form of a shrub.

Silver was known to the ancients, but it is not ascertained with any certainty whence they obtained it. We find by the XXIII. chapter of Genesis, that this metal was not only known, but used in commerce, 3700 years ago, or 753 years before the foundation of Rome.

Nero and his wife are said to have had their horses shod with Silver; but I have read, that on one occasion the city of Lima was paved with ingots of Silver. Statues and ornaments of Silver are by no means uncommon in the rich Cathedrals of Roman Catholic countries. Radama, late King of Madagascar, was buried in a coffin of Silver, 8 feet long, $3\frac{1}{2}$ feet deep, and of the same width, made out of 12,000 Spanish dollars; and 10,000 hard dollars were laid in the coffin, as a cushion for the corpse, and in the grave all his plate was placed. But I must now conclude the subject of Silver, as I mean yet to speak to you in this same letter of another metal.

Mercury, or Quicksilver.—This curious metal, known to every one, is most remarkable among the class of bodies to which it belongs, for remaining fluid at the ordinary temperature of the atmosphere, in temperate regions. In this, its usual state, it has the brilliant whiteness of Silver, and, when pure, neither rusts nor tarnishes by exposure. It has neither taste nor smell, and feels particularly cold;

it is, after Platinum and Gold, the heaviest of the metals; its specific gravity is 13·568. It congeals and becomes solid at 39 degrees below the zero point of Fahrenheit's thermometer, that is, 71 degrees greater cold than is necessary for the freezing of water. Here, in our climate, it is generally fluid, while in the northern regions it not unfrequently freezes in severe winters. When solid, it crystallizes in octahedrons, is sectile, and so malleable that it may be beaten into leaves as thin as paper; this indeed was actually done at Hudson's Bay, previously reducing the anvil and hammer to the same low temperature. When some of this Mercury was plunged into a glass of warm water, the metal became fluid, and the water froze with such rapidity that the glass was shivered into a thousand pieces. The specific gravity of solid Mercury is 15·612. Mercury is oxidized by heat; but at 600 degrees the oxygen is again driven off, and the metal revived. At 656 degrees, it is converted into an invisible and elastic vapour, of great explosive force if confined. Its protoxide is black and poisonous, its peroxide is red and mild. Quicksilver is so extremely divisible, that it may be strained by moderate pressure through the pores of leather, and this is a very ordinary method of purifying it from dust. As it is frequently adulterated with lead and bismuth, which, in certain quantities, may be dissolved in it without effecting its fluidity, it may be separated from these metals by distillation, having first mixed with it an equal quantity of iron-filings. It is easily soluble in nitric acid.

This valuable metal is found in its native and

fluid state, also as an amalgam with silver, and mineralized by sulphur and by muriatic acid.

NATIVE MERCURY occurs disseminated in different gangues, where it forms small globules in the cavities of the rocks, and sometimes, though rarely, larger masses collected together in larger hollows; it almost always accompanies the ores of Mercury. In Europe, it is found in Idria, Upper Hungary, in the Palatinate, in Deux-Ponts, Salzburg, Bohemia, Andalusia and Arragon—in Sicily and Sardinia. In South America, its principal repository is Guanca Velica.

NATIVE AMALGAM is silver-white, solid, and even frangible, which latter character distinguishes it from native-silver; its fracture is conchoidal, and it occurs usually in small rounded pieces or in octahedral crystals; it is a rare mineral, and is found in Hungary, Deux-Ponts, Sweden, and a few other localities. The blow-pipe flame drives off the Mercury, leaving a bead of silver. It whitens the surface of copper when rubbed upon it, which silver does not.

SULPHURET OF MERCURY, or *Cinnabar*, is the most abundant ore of this metal. It has been divided into three or four sub-varieties. Thus one author divides it into compact, fibrous, pulverulent, and hepatic; while another has only the dark-red, light-red, and hepatic varieties. Generally, however, it may be said, that its colour varies from carmine through cochineal-red, to lead-grey or black. In the latter case it is opaque, and has a metallic lustre; when it is red it is more or less translucent, and exhibits an adamantine lustre. Its specific gravity, when pure, is 10·218; but it varies usually from 6·7 to 8·2. It

crystallizes in hexahedral prisms with terminal facets of such length as almost to obliterate the prism; the streak is bright scarlet; before the blow-pipe it melts, and is volatilized with a blue flame and sulphureous odour. When sublimated, it crystallizes in columnar masses.

Pulverulent Sulphuret of Mercury is called *Flowers of Cinnabar*, or *Native Vermilion.*

The *Hepatic Cinnabar,* so called from its liver-brown colour, is sometimes nearly iron-grey or black; it occurs both compact and slaty, is always opaque, and is brown in the streak. It is generally impure but very rich, yielding from 84 to 85 per cent. of Mercury.

It is from the Sulphuret of Mercury that the greater part of that metal is procured by sublimation.

The ores of Mercury are more frequent in secondary than in primitive rocks; they occur chiefly in sandstone and bituminous shale; but this metal is not widely distributed: its mines are few in number. Those of Austria are, however, rich in the quantity of ore they contain. It is said that in fifty-six months, from 1809 to 1813, they produced 1,419,425 pounds of Mercury, 270,029 pounds of vermilion, and 76,225 pounds of lump-cinnabar, besides 6,400 pounds of calomel, 2,867 pounds of red precipitate, and 2,450 pounds of corrosive sublimate.

In 1803 there was a conflagration of these mines (of Idria), and the mercurial sublimations from this fire occasioned the most dreadful diseases among 900 persons.

The Spanish mines of Almaden, in the province of La Mancha, are nearly as rich as those of the Friul:

since 1827 they have produced, with 700 miners and 200 smelters, 22,000 cwt. of mercury every year. This is chiefly exported to Spanish America for the amalgamation, by which the gold and silver of that country are obtained from the ores.

The mines of the Palatinate are the next in importance, and lastly those of Hungary, Bohemia, and other parts of Germany.

The mines of Guanca Velica, in Peru, are very rich; they are said to have furnished 537,000 quintals of mercury between the years 1570 and 1800.

Japan and China also possess mines of Mercury. In the latter country, if we can believe Father Dentrecolles, not only the mines, but the vegetable kingdom supplies Mercury; he says, and that very seriously, that the Chinese obtain Mercury from the wild purslane, and he describes the process, which is very absurd. It is, however, asserted by other travellers, that the apothecaries in China keep in their shops two kinds of Mercury; the one obtained from the mines, and the other from the plant just mentioned, and that the two have different names.

The name of *Quicksilver* is said to have been given to Mercury by the Alchemists, who regarded it as silver in a fluid state, quickened by some inherent principle which they hoped either to fix or expel.

According to Pliny, the Greeks imported red Cinnabar from Almaden, 700 years before the Christian era; and Rome, in his own time, received annually 700,000 pounds of it from the same locality. They are said to have used it for the extraction of the precious metals from their ores and gangues.

Mercury readily combines with gold, silver, lead, tin, bismuth, and zinc; more difficultly with copper, arsenic, and antimony, and scarcely at all with platinum, or iron. It does not unite with nickel, manganese, nor cobalt.

The uses of Mercury are many and important. Various chemical preparations are made with it, some of which are very extensively used in medicine, and with great effect. Some are a deadly poison; such is the corrosive sublimate, the antidote to which is, the whites of eggs taken in a large quantity, which converts the sublimate into calomel.

Water-gilding, as I before observed to you, is effected by means of Mercury, and for this purpose a very large quantity is used in France for the gilding of their bronzes.

For all those purposes of science or the arts, where it is necessary to ascertain temperature and atmospheric pressure, Quicksilver is invaluable; it being used, as you know, for thermometers and barometers. But as it congeals in very cold regions, it is necessary, for observations near the poles, and sometimes for those made above the region of perpetual congelation, to use thermometers filled with spirits of wine, coloured to render it visible. It would be foreign to my purpose to enter here into a description of these two important instruments, accounts of which you will find in any encyclopædia, and which I recommend you to look into for information on the subject

Two of the applications of Mercury cannot fail to interest you. I know I nearly offended you before by allusions to the looking-glass; but, in

spite of all you may say, I cannot conceive what the ladies would do without their mirrors. Well, the reflecting property of mirrors is due to the amalgam of Mercury and tin, which is fixed to the hinder surface of the plate of glass. Sheet tin is laid on an even table of marble, and over this quicksilver is spread ; the glass is then laid upon this and pressed down with heavy weights, to squeeze out the excess of the Mercury ; the table being then raised a little, the Mercury runs off, and the glass-plate being removed, the amalgam is found adhering to it.

The next use of Mercury, to which you cannot be indifferent, is for the preparation of that very beautiful pigment, vermilion ; which I have no doubt you have long employed without knowing any more about it, than that you bought it at Mr. Newman's, in Soho Square, or elsewhere. Vermilion, then, is nothing more than a combination of one hundred parts of Mercury, and sixteen parts of sulphur. The Dutch are supposed to be possessed of some particular secret, by means of which they make this beautiful colour better than any other people in Europe. In one establishment alone, in Holland, no less than 48,000 pounds of vermilion are prepared annually; this great quantity will perhaps surprise you, but you must remember that all the red sealing-wax of good quality is coloured with it, the consumption of which, despite the sentimental and fancy wafers, is very great.

One of the most important of the applications of Mercury, however, is that by which silver is separated from its ores. It would be too long to describe the process employed, I will therefore merely tell

you that the ores, being previously roasted, pounded, and otherwise prepared, are placed with lumps of iron, water, and a certain quantity of Mercury, in barrels that are fixed horizontally to axles; these barrels are then set to revolve for a certain time by means of machinery, and by this process the Mercury dissolves all the silver contained in the ore. The Mercury thus charged with silver is then run off and squeezed through leathern bags, by which the superabundant Mercury is recovered; the pasty amalgam that remains is subjected to fire, which drives off the last portions of the Mercury, leaving a porous mass of silver: this is then melted, and run into moulds. In this way, the silver-mines of Mexico alone consume annually 2,000,000 pounds of Mercury.

The last use of this metal which I shall mention, is one that concerns your brother; and as you wrote to me, that he was interested in what I communicated in a former letter respecting flints, he may like to know that the percussion-caps, now used in place of flints, are filled with a preparation of Mercury.

This fulminating material is obtained by dissolving one hundred grains of Mercury in one ounce and a half, by measure, of nitric acid. This solution is poured cold into two ounces, by measure, of alcohol, in a glass vessel, and heat is applied till effervescence is excited. A white vapour undulates at the surface, and a powder is gradually precipitated, which is immediately collected on a filter, well washed, and cautiously dried. This powder detonates loudly, by gentle heat or slight friction.—For the caps, two grains and a half of it are mixed with one-sixth part

of that weight of gunpowder for the quantity of one percussion-cap. There is another kind, made with chlorate of potash, but it is much inferior to that prepared with Mercury.

I said that China produced Mercury. According to Berzelius, some is imported from that country, and in a somewhat curious manner. It is contained in portions of bamboo. This cane is cut at the joints, so that the portion between each joint is a hollow cylinder, closed at either end by a natural diaphragm. A hole being made in the diaphragm of one end, the Mercury is poured in, after which the whole is closed up with melted pitch, and the bamboo vessel wrapped round with a cloth steeped in pitch. One of these cane cylinders contains twenty-six pounds of Quicksilver.

LETTER XXVI.

Native Copper—Sulphuret of Copper—Purple or Variegated Copper—Red Oxide of Copper—Black Oxide of Copper —Carbonate of Copper—Blue Carbonate—Green Carbonate, or Malachite—Dioptase—Sulphate of Copper—Copper of Cementation—Copper Schist—Uses of Copper—Verdigris—Verditer—Bremen Green.

YOU will have observed, my dear Florence, that three out of the four metals of which I have already spoken, bear names derived from the Heathen Mythology; the first that of Apollo, the second that of Diana, and the third that of Mercury: the next I am about to mention, Copper, was called after the Beauty *par excellence*, Venus; but why or wherefore, it does not seem so easily to determine, unless it be on account of its refractory nature; for it is a metal that requires a great deal of rough usage before it is brought to the docile state in which we are desirous of having it. Now this is not unfrequently the case with your extraordinary beauties. If such were the reason of the name, it was certainly more malignantly witty than gallant. As for the beauty of the metal itself, tastes may differ; all I can say of it is, that it certainly is remarkable for a very brazen-faced appearance, which I think is anything but beautiful.

It is asserted that the first copper-mines known to the ancients were those of the Island of Cyprus, whence the name Copper; and as the lady Venus was of some little note in the said Island, the metal,

it is said, was consecrated to her;—but to our more matter-of-fact concerns.

Copper, if not the most important of the metals, is unquestionably one of very extensive and general utility. In its metallic state its colour is a bright reddish-yellow. It is very malleable, flexible, and ductile; harder and more elastic than silver; is the fourth in order of ductility and the third in tenacity; is less fusible than gold, but more so than iron, and is the most sonorous of the metals. Its specific gravity, after having been melted, is 7·788; when rubbed it emits a peculiar and disagreeable odour, and has also a nauseous taste. It melts at twenty-seven degrees of Wedgewood's pyrometer; its oxigenation, on mere exposure to the air, is very slow.

It occurs native, in different states of oxidation, in combination with other metals, and mineralized by different substances. The treatises on Mineralogy divide the genus Copper into about thirteen different species, and subdivide these again into a number of varieties; but, as I have already done, and as I shall continue to do, in the case of the metals, I will merely call your attention to the more interesting of the ores of Copper, after saying a word on the native metal.

Native Copper has all the characters of the pure metal obtained by metallurgical processes, only its specific gravity is greater, being from 8·5 to 8·9. It occurs ramose, in filaments, in plates, in grains, in concretions, stalactitic, amorphous, and crystallized in cubes and octahedrons. The crystals are not unfrequently macled. It is soluble in nitric acid and in

ammonia; to the former it communicates a green, and to the latter a fine blue, colour. Indeed, these two re-agents are universal tests for the presence of Copper, as they are invariably coloured by it in the way just mentioned.

Native Copper is abundant in some of the Cornish mines, from which very pretty specimens are obtained. It occurs also in the Shetland Islands, in Norway and Sweden, in the Hartz, in the Saxon Erzgeberge, in Thuringia, in Salzburg, at Oberstein, in France, Suabia, the Bannat, and Hungary. In Asia, it is abundant in Siberia and in the Kurile Islands, where large masses of it are found; also at Kamtschatka, China, and Japan.

In North America, in Mexico, and at Coppermine River; also the South of Lake Superior, where Dr. Baron, an American, discovered a block twelve feet in circumference at one end and fourteen feet at the other!

In South America, very large masses are met with in the Brazils, lying on the surface of the soil. On one occasion, a mass 2600 pounds weight was found. It occurs likewise in Chili.

SULPHURET of COPPER, or *Vitreous Copper*, is lead-grey or iron-black, often tarnished, and sometimes iridescent. It is hard or soft, according to the varieties; it occurs both massive and crystallized in hexahedral prisms and forms derived from this. The crystallized varieties are abundant in, and are almost peculiar to, Cornwall. This ore is also met with in other parts of Europe; it is very rich and much valued by the miners.

PURPLE, or VARIEGATED COPPER, occurs massive

and crystallized; the former copper-red, the latter tombac-brown, with an iridescent tarnish, most frequently blue. The general form of the crystal is cubical. This ore is reducible by the blow-pipe, and soluble in nitric acid; it is, like the former, very rich in metal, and equally abundant.

Copper Pyrites, or *Yellow Copper*.—This, though not the richest ore of Copper, is the most abundant of any; furnishing at least one-third of all the Copper we have. It is an impure sulphuret, containing a large quantity of iron, and sometimes minute portions of gold or silver. Its colour is brass-yellow, which is so much the deeper as the ore is richer. The surface sometimes exhibits the most beautiful variety of iridescent colours. The primary form of its crystals is the octahedron; but their general form is that of a tetrahedron, variously bevelled and truncated. It occurs also stalactitic, botryoidal, mammillated, and amorphous. Its structure is perfectly lamellar; its fracture sometimes uneven and sometimes conchoidal; and its lustre is splendent. This ore may be cut with the knife, which distinguishes it from iron pyrites. It fuses on charcoal before the blow-pipe, and, with the aid of borax, which it colours green, yields a globule of copper. In dilute nitric acid it forms a green solution.

Yellow Copper occurs in all the great classes of rocks, associated with various other metalliferous and earthy minerals. In our own islands it is found in the Shetlands, in Perthshire, in Derbyshire, Staffordshire, Cornwall, the island of Anglesea, (which formerly yielded 20,000 tons of Copper annually,) and in Wicklow, in Ireland. It occurs also in many

places on the continent of Europe; also in Asia, America, and Africa.

This ore yields upon an average about twenty per cent. of Copper. Jameson says, that in Cornwall there is raised annually 73,700 tons of Yellow Copper Pyrites, yielding 6,425 tons of Copper, valued at £410,936.

Red Oxide of Copper.—This is an exceedingly pretty mineral when crystallized; but it occurs also massive, disseminated, in membranes, and in concretions; its colour is dark cochineal-red, sometimes inclining to lead-grey: its crystals are octahedral, their colour is a darker red than the other varieties, passing sometimes into carmine-red; and they are more or less transparent. The hardness of this mineral is about that of fluor-spar; it is brittle, and its specific gravity is from 5·6 to 6·0. The crystals are sometimes an inch in diameter, and coated over with green carbonate of Copper.

The Red Oxide of Copper is divided into three or four sub-species; but their general character is as follows:—They are easily reduced to the metallic state by the blow-pipe. If powdered and thrown into nitric acid, a violent effervescence takes place, the Copper is dissolved, and the solution becomes green; this character distinguishes it from both red-silver and cinnabar, for which it might be mistaken, as red-silver does not effervesce in the acid, and cinnabar is not dissolved in it. It is the richest of the ores of Copper, yielding from 85·5 to 99·50 of metal. This ore occurs in veins traversing primitive rocks, and is associated with other ores of the same metal, and other minerals. It is found in Cornwall and

various parts of Europe; also in Asiatic Russia, in Chili, and Peru.

Black Oxide of Copper is very rich in metal, but is not abundant. It occurs generally as a coating on Copper Pyrites and other ores of Copper; it is black, heavy, and soils the fingers.

Carbonate of Copper.—The Carbonates of Copper are very beautiful minerals; they occur of two colours, blue and green.

Blue Carbonate of Copper is of a very rich and beautiful Berlin-blue, sometimes so dark as to appear almost black; its powder is a clear light blue: it occurs crystallized in different forms, sometimes translucent and sometimes opaque; the fracture is conchoidal and the lustre vitreous; it yields easily to the knife, fuses before the blow-pipe, colouring the flux green, and dissolves with effervescence in nitric acid.

The finest specimens occur at Chessy, near Lyons, and in Siberia; fine crystals are also found in our Cornish mines. There are massive, and also earthy varieties of this mineral, and amorphous rounded concretions, occasionally of considerable dimensions. It is very rich in Copper, but is not abundant, comparatively speaking. Perfect specimens of the Blue Carbonate of Copper are among the greatest ornaments of a mineralogical cabinet.

Green Carbonate of Copper.—This is also a most beautiful mineral, generally known by the name of *Malachite*, derived, it is said, from the Greek name of the Marshmallow. The colour of this mineral is green, of various shades and tints. It very rarely occurs crystallized, and even then, the crystals are

extremely minute and generally macled. Before the blow-pipe, with borax, it yields a bead of Copper, and colours the flux green; in nitric acid it is wholly dissolved with effervescence. The usual forms of this mineral are the globular, reniform, botryoidal, and stalactitic; it also occurs in stellar aggregations of great beauty: of this kind I possess a splendid specimen. When the botryoidal varieties are cut, they exhibit concentric circles of different colours most agreeably arranged, and take a fine polish. Malachite is sometimes found in very large masses; thus there is one at St. Petersburg about three feet long, two broad, and as many thick; but another and very much larger block has been lately discovered in the Siberian mines. The Green Carbonate of Copper is met with in various places in Europe, Asia, Africa, and America, in company with other ores of Copper; it is however most abundant in Siberia, whence the finest specimens are brought.

Dioptase is another very beautiful mineral, resembling the finest emeralds in colour. Its crystals are elongated rhombic dodecahedrons. It may be reduced by the blow-pipe, but with difficulty; it is insoluble in nitric acid, but dissolves without effervescence in muriatic acid. It occurs in the Khirghis Steppes of Siberia.

Sulphate of Copper is a native salt, known to most people by the name of Blue Vitriol. Its colour is a deep sky-blue passing into bluish green. It occurs massive, stalactitic, and pulverulent; is translucid; of a nauseous taste, and is poisonous. When artificially prepared it crystallizes. It is easily dissolved in water, and affords a blue solution. Iron

plunged into this is immediately coated with Copper. This salt occurs principally in the Hartz, in Sweden, and in Hungary; also in Anglesea, Cornwall, and Wicklow in Ireland. What is termed COPPER OF CEMENTATION is procured in great quantity from the salt naturally dissolved in the water that flows from certain Copper-mines. From these waters the Copper is sometimes spontaneously precipitated; but, in general, old iron is thrown into the water, which determines the precipitation of the Copper.

There are several other salts of Copper, as Muriates, Phosphates, &c.; one of them, an arseniate, called *Euchroite,* is a very beautiful mineral of a bright emerald-green and transparent; it is found in Hungary.

COPPER SCHIST.—At Maansfeldt there is an extensive formation of Schist containing Copper, which, although it yields but one per cent. of the metal, is worked with great advantage. These Schistose beds abound in fossils, and it is not at all uncommon to find fish completely changed into Copper pyrites.

Copper, as I have said, is a most useful production of nature, both in the state of metal and in that of salts and oxides prepared with it. It is one of the most refractory of the metals, requiring a very great number of processes, and great practical ability in those by whom they are performed, in order to obtain a perfectly pure Copper from the ores. In 1832 the annual produce of the United Kingdom was estimated at 14,465 tons, of which quantity Cornwall alone furnished 12,099 tons, valued at more than one million pounds sterling. The Cornish ore, for want of fuel on the spot, is all sent to South

Wales to be smelted. The exhalations from the Copper-smelting works are very detrimental to both animal and vegetable life, on account of the arsenical and sulphureous fumes which they contain.

Metallic Copper is brought to market in different states, according to the purposes for which it is intended; it is either in grains, or sheets, or ingots, or in bars.

Metallic Copper, either alone or alloyed, is applied to purposes innumerable. In sheets, it is extensively used for covering the lower parts of the hulls of vessels, and also for roofing: thus the Halle au Blé, at Paris, is covered with sheet Copper, as are all the gilded roofs of edifices in the sumptuous East, and the gilded spires, and balls, and crosses, &c. of European churches. Sheet Copper is likewise employed for the manufacture of a vast variety of caldrons, distilling apparatus, culinary vessels, &c. For the latter purpose it is, to a certain extent, dangerous; for if fat substances and acids are allowed to remain in Copper vessels when these are cold, verdigris is formed, which is a violent poison, and has, in some cases, occasioned the most acute sufferings and death. Experiment has, however, satisfactorily shewn that if the vessel and its contents are hot, no danger is to be apprehended; concentrated vinegar has been boiled in Copper vessels, and the most delicate tests have failed to detect the presence of the minutest particle of Copper in the acid. Nevertheless, for safety's sake, we take the precaution of tinning our Copper pans. The covering of tin is however, extremely thin, twenty grains of tin being sufficient to cover a foot square of the surface of a

Copper vessel. In Sweden and in China they take a much better precaution, which is, the prohibition altogether of Copper vessels for culinary purposes.

As Copper does not strike fire like iron, it is used in place of the latter metal in all the machinery of gunpowder-mills, and for powder-magazines.

The sonorous quality of Copper renders it peculiarly fit for many musical instruments, which are accordingly made of it, sometimes pure, and sometimes alloyed with tin or zinc.

Nails and ships' bolts are also made of Copper. This metal by rolling, pressing, or hammering, acquires a greatly-increased density, in the proportion of 580 to 620. A very great quantity of Copper is used for coin in most European countries, though, in some, the lower coins are made of a whitish alloy. It answers admirably for medals, and was used for this object at a very early date.

Drawn into wire, Copper is applied to many purposes, and a large quantity of it is used for the electric telegraphs now becoming so general. Copper-wire is so tenacious, that a wire of less than one tenth of an inch in diameter will sustain a weight of 175 lbs. without breaking.

Copper is so ductile, that it may be beaten into leaves of extreme thinness, called *Dutch Metal;* these leaves are employed for toys.

Philosophical instruments of all kinds, bells, cymbals, gongs, specula for reflecting telescopes, microscopes, &c., statues, cannon, breastplates, helmets, clock- and watch-work, boxes for wheels, ornaments for carriages and harness, door-locks, hinges and handles, brackets, rings, candlesticks, pins, wire for

musical instruments and for a thousand other purposes, together with a much greater multitude of objects than I can enumerate, are all made of alloys of Copper, with tin or zinc, or both together, and occasionally nickel, lead, and iron. These metals are mixed with the Copper in different proportions according to the objects for which the alloys are wanted. These alloys themselves are known under various names, as Bronze, Brass, Bell-metal, Tutenag, Pinchbeck, Prince's Metal, White Copper of China, German Silver, &c. You may form an idea of the importance of some of the arts which employ the alloys of Copper, from the fact, that in Paris there were, many years ago, according to Chaptal, 900 manufactories of bronzes, giving employment to 6000 workmen, the annual value of the produce being 35,000,000 francs, or £1,458,333. Of pins alone no less than 15,000,000 per day are required for the home-consumption and exportation of this country.

Besides the alloys of Copper, salts and oxides of this metal are much employed. Thus, blue vitriol is extensively used in dyeing and calico-printing, and of late has been in considerable request for the purposes of electrotyping. It is also used for bronzing urns, fowling-pieces, &c.

Verdigris, so well known, is an acetate of Copper, and is extensively prepared at Montpellier, and other wine-growing countries, by means of the refuse of the grapes after extraction of their juice.

Blue Verditer, another well-known pigment, is also a preparation of Copper, being the oxide of that metal precipitated by lime from a solution of the nitrate; it is much used in paper-staining.

Bremen Green, called *Verditer; Scheele's Green*, &c., and also a fine chocolate-coloured pigment, are prepared from Copper. A very beautiful and cheap red is produced by an artificial precipitation of the protoxide of Copper.

As some of the preparations of Copper are used in the colour-box for painting in *aquarelle*, you must not forget that all the salts and oxides of this metal are poisonous. The antidote is large quantities of sugar and sulphuretted hydrogen waters.

An oxide of Copper is used for colouring glass green, and is likewise employed for enamel- and porcelain-painting.

Copper was known to the ancients before iron, as is proved by the brass tenons used for fixing works of sculpture, blocks of stone, &c., the old gate-hinges, armour and arms that have been found, and which are of great antiquity. The alloy used for arms was very hard, and susceptible of taking and keeping a very keen edge.

The greater part of real antique bronzes, medals, &c., are covered with a venerable rust, called *Patina Antiqua*, which is either green or black, and sometimes so hard that a steel tool will hardly bite upon it. This *Patina* is the subject of the antiquarian's veneration, and some ludicrous stories are told of very orderly, but ignorant housekeepers, who have sadly annoyed their masters by a regular scouring and brightening of his "nasty rusty brass, that was a discredit to the house, and looked as though neither sand nor elbow-grease were to be had."

I think I said that one of the alloys of Copper was used for specula. We are told on this subject

by Pliny that mirrors made of this alloy were highly prized at Rome, while mirrors of silver were used only by the servants.

The Egyptian women formerly, when they went to the Temple, always carried a mirror of speculum-metal in their left hand. As I have also mentioned the beautiful tarnish of some of the Copper ores, I will tell you how you may easily obtain this pretty pavonine appearance artificially, and with this I will conclude the article Copper, and this letter.

Take a crystal or fragment of yellow Copper (Copper pyrites), place it in a solution of sulphate of Copper (blue vitriol), and touch it with a slip of zinc; electrical action immediately commences, and in a few seconds a beautiful violet colouration spreads over the surface of the mineral, which should then be removed and wiped dry, when the tarnish becomes more apparent, and passes gradually into other tints. If the mineral be suffered to remain too long in the solution, the blue colouration will be entirely concealed by a dull red precipitate of metallic Copper which takes place upon it.

LETTER XXVII.

Native Iron—Meteoric Iron—Iron Pyrites, or Marcasite—Arsenical Pyrites, or Mispickel—Oxydulated Iron-Ore, or Native Loadstone—Specular Iron—Hæmatite—Red Hæmatite—Brown Hæmatite—Compact Brown Iron-Ore—Bog-Ore—Pea-Ore—Spathic Iron-Ore—Phosphate of Iron—Chromate of Iron—Ochres—Clay Iron-Stone—Cast-Iron—Wrought-Iron—Steel—Uses of Iron—Loss of Iron—Salts of Iron, and their uses—Eagle-Stone.

"NONE but the brave deserve the fair," was, if I remember rightly, one of my copies when at school; it does not always happen, however, that they come together. I did, nevertheless, intend to send Mars to you in company with Venus, but as this was not practicable, I gallantly expedited the lady first. Allow me now, dear Cousin, to introduce to your notice Mars, for so was Iron called by those who named copper Venus.

When iron came to be used for arms, the propriety of consecrating that metal to the god of war became evident. By the ancient Scythians, his godship was represented as an old rusty sabre, sprinkled occasionally with the blood of one of their enemies killed in honour of him. The ancient Gauls, also, admitted Mars as one of their inferior deities, and worshipped him under the form of a naked sword, placed on an altar in one of their sacred groves.

The name of Iron has become metaphorically associated with injustice, harshness, slavery, rigidity of character, &c., all characteristic of the Iron Age. But our own times are pre-eminently Iron, both in

the proper and in the metaphorical sense. While Iron is covering the surface of the earth in every possible form, the iron-principle of utilitarianism is becoming every day more despotic, to the utter exclusion of all the poetry of life. Arcadian Shepherds and a Golden Age, once a pleasant dream if not a reality, are now regarded as the hallucinations of a disordered intellect; in these days no man is wise, or great, or good, but inasmuch as steam or iron make him such. But let us not be unjust: Iron answers many and important purposes; the ink I am now using is prepared with iron; the pen that traces these lines, is of iron; and to an iron-road we are indebted for the rapidity of our mutual communications.

There is no metal of such extensive and varied utility as Iron, and the great abundance in which it is distributed in and upon the surface of the earth is a fresh proof of the goodness of the Creator, who, foreseeing the wants of man, has so amply provided for their satisfaction. Iron pervades more or less almost every object of nature; it exists in plants, in animal fluids, and is the colouring matter of many earths and stones. The forms and appearances under which it occurs are extremely various, and the proportions in which it is united to other minerals are so different, that, as M. Brongniart very justly remarks, it is difficult to separate the ores of iron from those substances in which the metal enters merely as an accidental or accessary ingredient. You will not, therefore, expect me to enter into details of all the substances ranged under the genus *Iron*, and bearing different names. Of these, Phillips enumerates no

fewer than thirty-three species, and some of them present several varieties. I shall then, in this and similar cases, confine myself to the most important and interesting.

Native Iron has been, and with propriety, divided into *Terrestrial* and *Meteoric*. Of the Terrestrial, there exists at Canaan, in Connecticut, a vein about two inches thick, in mica-slate; this appears to be really a spontaneous production of nature. In the few other cases of terrestrial Native Iron that are mentioned, it would appear they are either accidental artificial masses, or metal reduced by volcanic fire and other adventitious agency. Thus, near the village of Bouiche, in the department of the Allier, in France, a kind of native steel has been found in small globules, imbedded in minerals scorified by the fire of a coal-mine formerly in a state of inflammation; and there is Native Iron in the volcanic region of Auvergne.

Meteoric Iron is a very remarkable production, from the difficulty of satisfactorily accounting for its appearance on the earth. That it comes to us from beyond our globe, there can, I think, be little doubt; but whether, as suggested by La Place, projected from volcanoes in the moon, or, as thought by others, engendered in our atmosphere, it is hard to say. My own opinion is in favour of a third hypothesis, which considers the fragments of Meteoric Iron, and aërolites generally, as masses moving through space, and which, coming within the sphere of the earth's attraction, as our planet proceeds in its orbit, are arrested and brought to the earth's surface. A fourth hypothesis supposes them launched from our own

volcanoes. I need scarcely impress upon you that all these are mere conjectures, and as such not worthy of detaining us longer.

Meteoric Iron has been found in many places, it is generally solid, and usually contains a small per centage of nickel. Some specimens have been met with that are full of holes containing small crystals of a greenish-yellow olivine: but they are generally solid. Jameson enumerates twenty-one different masses of Meteoric Iron in different parts of the world, of various sizes and weights; one of these, discovered by Bougainville, the French circumnavigator, on the banks of the La Plata, in South America, was calculated to weigh 100,000 pounds. Another, in the district of St. Jago del Estro, in South America, weighed about thirty tons. "Avarhoes speaks," says Jameson, "of swords having been made from a mass of Meteoric Iron weighing 100 ℔s., which fell at Cordova, in Spain." No doubt, that in those superstitious times, these swords, of which the substance was sent direct from heaven, were regarded as assuring the victory to those who used them. According to Ross, in his "Arctic Voyage," the Esquimaux make their knives from two pieces of Meteoric Iron found in Greenland.

Iron Pyrites, or *Sulphuret of Iron*, formerly called *Marcasite*, is subdivided into several varieties. Its general colour is bright brass yellow, sometimes of a redder tinge, like that of bronze, sometimes steel, grey, or nearly tin-white, and occasionally brown. It cannot be scratched with the knife, which distinguishes it from copper pyrites, and is indeed so hard as to strike fire with steel; a property from

which the name *Pyrites* is derived, and which caused it, in former times, to be used for firing gunpowder in the pans of muskets, before flints were used for that purpose. Iron Pyrites occur crystallized in cubes or pentagonal dodecahedrons, and a few other forms; also amorphous, mamillated, globular, cellular, stalactitical, pseudo-morphous, capillary, &c. It not unfrequently invests other minerals. Its specific gravity is from 4·7 to 5·0. The globular masses are usually radiated, and are particularly susceptible of decomposition by exposure, passing into Sulphate of Iron. The crystallized varieties are some of them remarkable for the perfection of the crystals and their great size. They contain from 46 to 47 per cent. of Iron, the rest being sulphur. The lighter-coloured varieties contain a little arsenic. The brown variety is called *Hepatic Pyrites;* externally it is liver-brown, internally steel-grey, sometimes brown throughout. There is also a variety called *Auriferous Pyrites*, from its containing a small portion of gold. This latter kind occurs abundantly in the gold-mines of Berezoff, in Siberia, and in Brazil. The crystals are usually parallelopipedons, brown externally, with deeply striated faces, the striæ of any one face being in a direction perpendicular to those of the two contiguous faces. This variety yields 57 per cent. of iron. There is also a species which is magnetic, and which occurs both massive and crystallized in irregular six-sided prisms: the latter in Norway, and in the Hartz; the former in Norway, the Hartz, Saxony, Silesia, and Siberia; as also in Cornwall, Argyleshire, &c. Iron Pyrites have been taken for

gold by ignorant persons, a mistake which has sometimes led to unpleasant consequences. It is a mineral so universally diffused, that it is found in almost every species of rock, and you cannot fail to have frequently noticed it in coal. Our Cornish-mines produce cubic crystals of immense size, and some of our chalk abounds with very pretty specimens of the globular variety, remarkable for their external brilliancy when first dug out.

Iron Pyrites are never worked as an ore.

Arsenical Iron, or *Mispickel*, is generally of a tin-white colour; the arsenic in this species is in greater proportion than the iron; it is abundant in Cornwall and Devonshire. Some varieties contain so much gold that they are called *Auriferous Arsenical Pyrites*, and are considered an ore of gold; there is also a variety of it called *Argentiferous Arsenical Pyrites*,[1] containing from 1 to 13 per cent. of silver: this latter is found at Andreasburg, in the Hartz, and is worked for the silver it contains.

Oxydulated Iron, or *Magnetic Iron Ore*.—This species is interesting as being the *native loadstone*; it contains from 72 to 90 per cent. of iron. Its colour is iron-black with a glimmering metallic lustre; it occurs massive and sometimes also disseminated, in concretions and crystallized in regular octahedrons, usually small, and sometimes very small. It is most commonly met with in primary formations, and is particularly abundant in Sweden and Norway.—Dannemora, Gellivara, and the Taberg (a mountain of considerable dimensions), are entirely formed of it; and immense quantities of the very best bar-iron are annually obtained from these localities. Much of the

steel made in Great Britian was, and perhaps still is, prepared from this Iron. It is also found in many other parts of continental Europe, as likewise in Unst, one of the Shetland Islands, and in Cornwall. The most powerful magnets, however, occur in Siberia, Elba, Sweden, and the Hartz. This mineral is also met with in North and South America. In some places it exists in the form of sand, forming deposits in the bottoms of valleys, and in the beds of rivers and torrents. Thus it occurs on the borders of the Elbe; in Sweden; near Naples, on the sea-shore, near Chatelaudren in France, &c. This variety usually contains 30 per cent., more or less, of titanium. It occurs also imbedded in certain basalts and lavas. In Wicklow, in Ireland, it accompanies native gold; it is sometimes smelted, and affords capital bar-iron.

Oxydulated Iron has two poles, like the magnet, which poles may be easily discovered by presenting the mineral to a suspended magnetic needle, when the poles of the same name will repel, and those of different names attract, each other; that is, the end of the mineral which repels the northern extremity of the magnetic needle, is the north pole of the mineral. A block of this native load-stone, however, will not lift up a piece of iron until it is itself *armed*, that is, surrounded on three sides with iron, when the two ends of the arming will attract and hold a piece of iron, like the ends of a horse-shoe magnet.

Specular Iron is the most beautiful and brilliant of the Iron ores, more especially that variety of it which is crystallized, and is covered with an iridescent tarnish. It is very rich, containing from 70 to 94 per cent. of Iron. It occurs massive, disseminated,

and crystallized in a variety of forms, and is of a bright steel-grey, with a brilliant metallic lustre; its streak is cherry-red: it belongs to primitive mountains, and is found in Saxony and Bohemia; at St. Gothard; in Norway, Sweden, and elsewhere in Europe; also in Siberia; in Mexico, and in Chili. The most beautiful specimens, however, are from the island of Elba, where the mines have been worked for more than 3000 years, and now yield 132,000 quintals of ore annually. Nothing can equal the splendour of some of the specimens from this locality, though very fine crystallized masses are found in one or two of our Cornish mines. It affords an excellent malleable iron.

There is a micaceous variety of this mineral found in Devonshire and Cumberland, and in different places in Europe; also in Siberia and in Chili.

HÆMATITE is the name formerly given to an oxide of Iron, on account of its blood-red colour, though the same name being now also, though improperly, given to a brown and to a black variety of the same mineral, they are called respectively Red Hæmatite, Brown Hæmatite, and Black Hæmatite.

RED HÆMATITE, or *Red Iron Ore*, is a peculiarly rich and excellent ore of Iron, yielding from 60 to 98 per cent. of metal. It occurs principally in botryoidal and mamillated or globular masses, and in stalactites formed of concentric coats, and with a fibrous or radiated structure. Its colour is sometimes a dull reddish-brown, and sometimes very brilliant blueish or iron-grey; the streak is blood-red; it is hard and opaque. This mineral occurs also compact or massive, and presents occasionally crystalline

forms, which, however, are not its own, as it has never been found crystallized. The Radiated Hæmatite is found abundantly in Saxony, Bohemia, the Palatinate, Silesia, and the Hartz; also near Ulverstone in Lancashire, and, in smaller quantities, in other parts of England and Scotland; it is not common in France, but occurs in Siberia and Mexico. The earthy variety is found in the Fichtelberg, near Bareith, and elsewhere. It is worked to advantage.

Brown Hæmatite, or *Fibrous-brown Iron Ore*, occurs in the same forms as the species just described. In colour, it presents various shades of brown, from brownish-black, through clove-brown, to ochre-yellow; the shades being disposed in concentric curved bands. The texture is finely fibrous, and the aspect sometimes silky; its streak is always a yellow-brown. The surface of the masses is often covered with a beautiful black varnish, which is sometimes iridescent. It occurs in secondary rocks in different parts of Europe, particularly in Bohemia, and Syria, where it affords materials for extensive works. It is also found in the British islands. This ore affords from 70 to 80 per cent. of a very malleable, but much harder Iron than the Red Hæmatite, and excellent steel.

There is also a *Compact brown Iron Ore*, a *scaly* or *ochery* kind, a coarse kind called *Bog-Ore*, and a variety termed *Pea-Ore;* the latter consisting of grains quite round and smooth, formed of concentric layers, sometimes about the size of large peas, but frequently no larger than mustard-seed, or smaller still and flattish, like grains of gunpowder; which shews the impropriety of the name.

The pea-sized variety has been sometimes used as shot, a purpose for which it is very ill fitted, on account of its want of weight. It is very abundant in France, and is smelted at the celebrated works of Creusot, and other places. The Bog-Ores generally yield what is termed *cold shot* Iron, and which is only good for rough castings. Its brittle quality is supposed to be owing to the phosphoric acid it contains, which it derives probably from the decomposition of the organic substances going on where it is found.

Spathose Iron Ore is a mineral of a yellowish or brownish colour and sparry aspect, of lamellar structure and pearly lustre. It occurs massive, disseminated, and crystallized: in the latter case, the forms are those of carbonate of lime. It is a carbonate of iron, mixed, most frequently, with portions of magnesia and of manganese; and sometimes, not always, with lime. The proportion of the Iron and of the other ingredients is very various, and there seems to be a gradual passage of this ore of Iron into common *Brown Spar*, which is calcareous-spar with an accidental small portion of iron or manganese. The usual form of the crystallized varieties of Spathose Iron Ore is a very depressed obtuse-angled rhomboid, which becomes lenticular by the wearing away of the solid angles. Its specific gravity is from 3·6 to 3·9. It becomes brown in nitric acid, and also after exposure to the fire, when it is attractable by the magnet. The massive variety occurs in thick veins in primitive mountains, particularly in Styria and Carinthia. It is found also in other places, and amongst these, in Cornwall and Devonshire, and at Alston Moor. This

valuable ore not only produces the best iron for conversion into steel, but furnishes natural steel.

Phosphate of Iron.—This mineral, called also *Vivianite* and *Blue Iron-ore*, occurs in small prismatic crystals, whose colour varies from pale green to indigo-blue. It is met with in several places, but not abundantly, and is composed of iron and phosphoric acid. There is also an earthy variety which occurs as a powder, coating other substances, or in small pulverulent masses, and occasionally in spherical globules. As an ore it is of no value whatever; on the contrary, its admixture with other ores deteriorates the quality of the iron. If, therefore, I mention it at all, it is because you will find the earthy variety as a pale greyish blue powder among the peat where you are going; and, as it will not fail to attract your attention, it is right you should know what it is.

Sulphate of Iron, or *Green Vitriol,* or *Native Copperas*, is a salt that is by no means uncommon in connexion with Iron pyrites, from the decomposition of which it results; but its quantity is comparatively small: it occurs in a variety of forms, but is generally found as an efflorescence, being very rarely massive, and still more rarely crystallized.

Chromate of Iron is an iron-black mineral, which is either massive or crystallized; it occurs in veins at Unst and Fetlar, in Shetland; also in Banffshire. On the Continent, it is found in the department of Var, in France; in Silesia, the Ural Mountains, and elsewhere. It is a very valuable mineral, not as an ore of iron, but for the large quantity of chrome it contains.

Ochres.—These need hardly be mentioned; they are of different colours, from the bright red variety, known as *reddle*, to brown of different shades, and yellow; they are all, more or less, impure oxides of iron, generally mixed with clay.

The next and last ore of Iron, properly so called, which I shall speak of, is the *Clay Iron-Stone*, being that from which almost all the Iron smelted in Great Britain is obtained. It is a *Compact Carbonate of Iron*, and occurs in great abundance in pieces of a more or less flattened spherical form, and of various sizes, in the rocks, and beds, and veins, of the coal-formation. It is of different shades of yellowish-brown, reddish-grey, and dirty brick-red; its fracture is close-grained; it adheres to the tongue, and has, when breathed upon, an argillaceous odour. It yields from 30 to 40 per cent. of excellent iron.

It is a very fortunate circumstance, that, in most cases, the Iron-stone and the coal necessary for smelting it are found in the same locality. The coal-fields in the South of Staffordshire, those of Monmouthshire, in South Wales, with those of Gloucestershire and Somersetshire, supply more than three-fourths of the whole of the cast-iron produced in the kingdom.

The importance of our iron-works may be conceived from the fact, that in one establishment alone 600 tons of bar-iron were manufactured per week. Twenty years ago, there were 305 blast-furnaces in Great Britain, which produced 7,098,000 quintals of iron. These numbers must now be greatly increased, since the introduction of railways, iron vessels, iron bridges, &c.

Having thus given you some little notion of the principal ores of this valuable metal, and of the quantity produced in our own country alone, I will just say a few words upon Cast-iron, Wrought-iron, and Steel, and wind up with a hasty sketch of some of the more important purposes to which Iron is applied.

CAST-IRON is that which is run off in the melted state into moulds prepared to receive it. When Cast-iron is broken, its grain is found to be coarse and very brilliant. Every one of these grains of metal is thinly coated with a vitreous substance, a kind of glass, resulting from the fusion of the earths and fluxes mixed with the ore. It is this coating which prevents the perfect contact and adhesion of the particles of the Iron, and renders Cast-iron so brittle.

The names of *Pig* and *Sow* Iron are given to the ingots, or short thick lumps, into which the first coarse metal smelted from the ore is cast.

Cast-iron submitted to various processes of heating, hammering, &c. becomes not only deprived of the greater quantity of the vitreous matter it contained, but the particles of metal are brought into closer contact, and, after several doublings and rollings of the rods, the mass becomes so tough that it can hardly be said to be susceptible of breaking, it rather tears, leaving long filaments or splinters of metal at the place of separation, like those of a fresh willow- or hazel-stick when broken. This wrought iron is so soft and tough that it may, when heated, be twisted and bent in all sorts of ways.

The main difference, then, between cast- and wrought-iron is, that the former is very hard and

brittle, and the latter soft and tough; the former has strength of rigidity, the latter strength of tenacity.

STEEL is a compound of carbon and iron; it is obtained naturally from the spathose iron-ore already mentioned, but the greatest quantity is prepared by a process called *cementation*. Bars of wrought-iron, of the proper quality, are imbedded in charcoal reduced to powder, and the whole submitted to intense heat, in cases made of refractory bricks, and excluded from contact with the air; after a sufficient time the iron bars are found to be converted into Steel. There is also another process, the result of which is called Cast-steel. Steel is susceptible of taking a much finer polish than can be given to Iron; and by what is called *tempering* acquires great hardness and elasticity.

Cast-iron, Wrought-iron, and Steel, not only differ essentially from each other, but there is a great variety of each kind, according to the nature of the ores from which they are obtained, and the different metallurgical processes to which they are submitted.

Iron affords, in the mineral kingdom, as flax does in the vegetable, a striking example of the increased value given to the raw material by the labour and ingenuity of man. Thus a few pennies' worth of flax may be wrought into a veil of Brussels lace worth many pounds sterling; and one pound weight of crude iron, of the value of one halfpenny, being converted into Steel, may be made into 70,000 watch-springs, which, at half a guinea each, would make 35,000 guineas, or 17,640,000 times the original cost of the material!

Of the endless variety of purposes to which Iron

and Steel are applied, it would be as impossible for me to give you an enumeration as it would be absurd to attempt it. I may, however, mention a few of the principal, merely to awaken your attention to them.

Iron is extensively used in the arts of war as well as those of peace. Thus, towards the close of the last century, there was, besides the great quantity of iron used in the manufacture of muskets, pistols, sabres, &c., no less than 26,000 tons of this metal annually cast into cannon, carronades, mortars, shot and shells. In these "piping times of peace," however, if we have not altogether "converted our swords into ploughshares," it is certain that our iron-founders are working their metal into objects tending to unite mankind into one great community of friends. Railways are now so numerous, that the iron required for these extraordinary creations of our time is immense. Add to this, the thousands of miles of iron-pipes for the distribution of water and gas in our cities;—the bridges, pillars, railings, and balconies;—the anchors, chain-cables, and iron-ships;—the chains, the wire-ropes, and wire for every conceivable purpose;—the iron-bedsteads for hospitals, barracks, and private houses;—the grates, stoves, fire-irons, culinary vessels, and implements;—the ploughs, scythes, spades, axes, and agricultural implements of every variety; —machinery of every kind, from the largest and most complicated steam lace-making engine to a simple crane;—horse-shoes and tires of wheels;—nails and screws of every kind, in countless myriads;—tools for every kind of handicraft;—dies for coins and medals, &c.;—springs of all sorts, from the ponder-

ous and powerful springs of railway-carriages to the feather-springs of our chronometers and watches;—magnetic needles for ships' compasses;—cutlery of all sorts, needles, steel-pins, &c., &c., &c. Indeed, we cannot look around us without seeing Iron in some shape or other, and the quantity of manufactured Iron, if it could be ascertained, would surprise the imagination.

The wear and destruction of this metal is also enormous, though but little heeded. Take, for instance, horse-shoes and the tires of wheels. It is calculated that every coach-horse loses 4 ℔s. of iron a month from his shoes, and every heavy cart-horse 6 ℔s.; a coach continually running loses in the same time upwards of 136 ℔s. of iron. Now if we take 5 ℔s. for the medium in the case of the horse-shoes, the annual loss from only 10,000 horses and 5,000 coaches will amount to 1,280,000 ℔s. of iron! What then must it be for all the horses and coaches in the country, without counting the continual wearing away from rust, friction, breakage, &c. of the ten thousand other objects made of iron and steel!

But to return, it is not in the metallic state alone that iron is abundantly useful: its salts and oxides are extensively employed in the arts: of these, *Copperas,* or *Green Vitriol,* so well known to every one, is prepared in vast quantities from iron pyrites. It is a salt in great demand for dyeing black, particularly hats, for making ink, and Prussian blue; also for tanning, and painting, and many other purposes. In the preparation of it, another produce is obtained, namely, a cheap pigment in great demand, called *English Red.* There is also a red oxide prepared

directly from the green vitriol, and which, under the name of *crocus of mars*, *plate-powder*, or *rouge*, &c., is used for polishing the finer steel articles, the specula of reflecting telescopes, &c.

The earthy blue phosphate of iron is occasionally used as a pigment in water-colour, (in oil it turns black). Beautiful green and olive-colours have been formed by mixing it with other colours. It is very probable that the substance mentioned by Pliny as being found in the marshes of Egypt, and used as a pigment, was our phosphate of iron.

From the chromate of iron, in combination with other metals, magnificent green, yellow, and red colours are obtained, which are extensively used for painting and for porcelain.

From Iron, various ochres, red, yellow, and brown, are obtained both naturally and artificially : of these oxides there are two kinds referable to red hæmatite; the one from the island of Ormuz, in the Persian Gulf, and called *Indian-red,* is used as a colour ; the other called *Almagra*, is used in Spain for colouring snuff, polishing glass, &c. ; it comes from Murcia.

The radiated red hæmatite itself is used as a burnishing stone.

The arsenical pyrites are the chief source from which the white oxide of arsenic is obtained, and artificial orpiment is also prepared from it.

Iron pyrites, under the name of *marcasites*, were formerly cut and polished into buttons and similar ornaments, a fashion revived in Paris very lately.

The *Piedra de las Incas*, found in the tombs of the ancient Peruvians, appear to be polished specimens of iron pyrites, used probably as mirrors.

There is a scaly variety of specular Iron, brought by the Arabs from above the cataracts of the Nile down to Egypt, which the people use for sore eyes.

Among the curious facts relating to Iron, I may mention that at Nijno Tagilskoë, in Siberia, the altar of the church is formed of two blocks of *native loadstone.*

There is a variety of brown iron-stone called *Ætites* or *Eagle-stone;* it is formed of concentric coats, hard and dark brown outside, softer towards the centre, which is usually a cavity, either empty, or filled with pulverulent yellow ochre. This variety occurs in great abundance in certain beds, in secondary mountains and argillaceous strata. This mineral, Dr. Ure informs us, is used by the French shepherds as amulets and talismans, and may be found in the small bags which they suspend to the necks of their favourite rams. They are in such general use, that a large quantity is annually imported into France from the frontier of Germany for this superstitious purpose.

Iron has been used to span the brow of royalty—you have heard of the iron crown of Italy: it has also been used for a more sinister purpose in the case of the Iron Mask.

Finally, Iron properly prepared is a most powerful and efficient medicine.

And now, my dear Florence, I must conclude this letter, too long, I fear, for your patience, but which contains very little indeed on a subject upon which volumes might be, nay, have been written. Nevertheless, I hope I have said enough to give you some notion of Iron, and of its immense importance.

LETTER XXVIII.

Tin—Oxide of Tin—Wood-Tin—Lead—Oxide of Lead—Galena—Slickensides—Carbonate of Lead—Phosphate of Lead—Arseniate of Lead—Chromate of Lead—Molybdate of Lead—Uses of Metallic Lead—Minium—Massicot—Ceruse, or White Lead—Litharge—Nickel—Pimelite—Petit-Or.

IN all pageants and processions it is customary that the principal personage be preceded by others of inferior dignity; and thus it happens, though not intentionally on my part, that in marshalling before you the glittering array of metals under the assumed names of the heathen divinities, Jupiter, the head and chief of them all, comes after the less important personages of the Olympic Court. How Tin, so soft and flexible in its nature, came to be honoured by the alchemists with the name of the awful and inflexible Jove, I am unable to say, but so it is.

TIN is a very useful metal, and one which was very anciently known. The Phœnicians traded to Cornwall for it; and it is mentioned in the books of Moses, though conjectured by some that the metal there spoken of as Tin, was lead. Be this as it may, Tin possesses many valuable properties to recommend it. Its colour is agreeable; it is easily hammered, fused, and twisted; it is durable, and the lightest of the ductile metals; is not easily rusted, nor even tarnished, and if its splendour is lost, this is easily revived again. Tin alloys easily with other metals, or may be spread over them. Bars of

it emit, when bent, a curious crackling noise and a disagreeable odour. Though ductile, it has but little tenacity. A wire of one-tenth of an inch in diameter breaks with a weight of 49 lbs.

There is only one ore of Tin that is worked, and this is an oxide.

OXIDE OF TIN occurs in crystals, sometimes almost transparent, and sometimes opaque; and occasionally, though rarely, massive. The colour is from light-hair brown, through darker shades, to black; it is hard, brittle, and insoluble in acids. The crystals are splendent; they are usually prismatic, with square bases and pyramidal summits; they are often macled, and their streak is greyish-white. The specific gravity of this ore is from 6·4 to 6·7.

Besides the crystallized Tin-ore, there is a *fibrous oxide* called *Wood-tin*, which occurs in reniform and botryoidal masses, or in wedge-shaped pieces, which are fragments of the globular masses. It exhibits various shades of brown in concentric bands, giving it a ligneous appearance; the structure is divergingly fibrous in one direction and concentric lamellar in the other. Of this variety, specimens are sometimes found weighing several pounds.

The Oxide of Tin also occurs in the form of a brown sand.

The Tin-ore of Cornwall yields $77\frac{1}{2}$ per cent. of Tin.

Tin belongs to the very oldest rocks, as the Granites, Gneiss, and Mica-slates. When found in alluvial formations, it is the result of the decomposition of the older rocks.

Tin-ore is met with in different parts of Europe,

but its chief repository is Cornwall, where the mines of it were worked previous to the time of the Romans. Some idea of the importance of these mines may be formed from the fact that £40,000 worth of gunpowder is annually consumed in them for the blasting of the rock.

Excellent Tin occurs also, in large quantities, in Asia, particularly at Malacca and Banca, whence we import about 700 tons a year; part of this quantity is, however, re-exported, together with a great deal of our own produce.

The uses of Tin are various. I have already mentioned some of them when speaking of copper and mercury. One of its principal uses is for the covering of sheet-iron, which, when so covered, is improperly called Tin. This tinned iron is manufactured into a thousand useful articles for culinary and other purposes.

Some years ago, trays and many other objects were very much in fashion, under the name of *Moiré Métallique*. The pretty appearance of these objects was given by moistening plates of tinned iron with various acidulated liquors, and coating these over afterwards with transparent varnishes of different colours.

What is called *Mosaic Gold* is a preparation of tin and sulphur.

The vitrified oxide of tin is very hard, and is used for polishing other hard bodies, under the name of *putty of tin*.

The same oxide enters into the composition of white enamels, and for communicating to glass an opalescent appearance.

Finally, Tin is essential to the production of a beautiful scarlet dye.

The next metal of which I have to speak to you, dear Cousin, is

LEAD.—This is, probably, the most anciently known of the metals; and hence, perhaps, the reason of its alchemical dedication to old Saturn, the undutiful son of Uranus and Vesta, and father of Jupiter; who, as the story goes, was saved by his mother Rhea from being devoured, like the rest of her children, by her unnatural husband. This, by the way, may serve as a hint to you not to encourage the addresses of any likely to be too ambitious, or who might take a fancy to devouring the substance of his offspring. But to resume.

Lead is so well known in its external appearance, that to describe this is quite unnecessary; it is proverbially heavy, its specific gravity being 11·352. It is soft and easily melted; it has no elasticity, and is, accordingly, not sonorous; its tenacity is so small that a wire of one twelfth of an inch in diameter breaks with a weight of 18 lbs. It is, however, extremely malleable; but, what is extraordinary, it does not, like other metals, acquire any increase of density by hammering and rolling; indeed, Brisson tells us that its gravity becomes *less* by hammering.

The existence of *native lead* is very doubtful, thought it is asserted to have been found in lava in the island of Madeira. In this case it has, probably, been reduced from its ores by volcanic fire.

The ores of lead are very widely distributed; they are in considerable number and very different in their appearance, though all of them are easily reduced.

There are only a few, however, that are worked; these are the oxide, the sulphuret, the carbonate, the phosphate, the sulphate, the arseniate, the chromate, and the molybdate; and of these, the greater number occur in quantities too small to be smelted alone for the lead they contain. The principal ore, that indeed from which the whole of our Lead is obtained, is the sulphuret.

Oxide of Lead.—This mineral, which, as its name implies, is a compound of lead and oxygen, occurs of three principal colours, whitish, or *native Ceruse*, yellow or *native Massicot*, and red or *native Minium*, and of intermediate tints. It is both pulverulent and massive, and is easily reducible to metallic lead; it forms either little layers alternating with clay, or dispersed throughout the metallic veins at different places in Bohemia, Saxony, Silesia, the Hartz, and the Vosges. It is of no consequence as an ore.

Sulphuret of Lead, or Galena, is the most abundant of the lead-ores. Internally it has all the brilliancy of fresh-cut metallic lead; its texture is lamellar, granular, and sometimes striated; it occurs crystallized in cubes, in regular octahedrons, and in some of their varieties; also in amorphous masses having a largely curved lamellar structure. The crystals are dull externally, but some of them exhibit a beautiful tarnish. After the sulphur has been driven off, it readily melts into metallic lead, of which by analysis it contains from 60 to 85 per cent., though, in the large way, it does not yield above 70 or 75 per cent., which is still a great deal. The granular and striated varieties almost always indicate the pre-

sence of some extraneous substance, which is usually silver; indeed, some of the Galenas contain so much of this precious metal as to be considered an ore of silver, and worked as such. The association of these two metals is so constant, that perhaps there is no lead which does not contain some portion of silver. When the ore is striated, it contains a portion of antimony. The specific gravity of Galena is from 7·4 to 7·6.

This mineral occurs alike in beds and veins, sometimes extensive and thick, and accompanying other metalliferous substances and stones in both primitive and secondary rocks; but more especially in those of transition or mountain-limestone. It is abundant in Cumberland and Derbyshire, Cornwall, Devonshire, Yorkshire and Durham; in Flintshire in Wales, and at Leadhills in Scotland; in Fifeshire, the Island of Isla, and elsewhere. It also occurs in several parts of the Continent of Europe, and in North America.

Slickensides is a species of specular Galena found principally in the mines of Devonshire. It forms a thin coating upon quartz or other substances, exhibiting a smooth, sometimes slightly furrowed, polished, shining appearance, as if produced by friction.

Carbonate of Lead.—This mineral, sometimes of a brilliant white, passes into a greyish or yellowish white; its aspect is sometimes metallic, sometimes greasy. It occurs in small masses, or crystallized, or micaceous; it is very heavy, its specific gravity being from 6·3 to 6·6. It is easily reducible, and effervesces with dilute nitric acid. Its crystalline forms are usually prismatic. There is a beautiful variety which is acicular, the needles being either

detached or united together in a very brilliant pearly or rather silky mass; and likewise a columnar variety, in which the little columns are striated and cross each other in all directions, very much resembling a species of the sulphate of Barytes of the same form. There is also a massive compact variety of a yellowish colour, with a shining, but at the same time greasy-looking fracture; it effervesces strongly in nitric acid.

The Carbonate of Lead occurs along with the other ores of the same metal, and is very rich, yielding from 78 to 80 per cent. of lead. It is never found in large quantity. It occurs in Scotland and other places. The finest crystals come from the mines of Gazimour in Daouria.

Phosphate of Lead.—The usual colour of this mineral is green, passing from pure grass-green gradually to greenish-yellow; but it also occurs of a greyish-brown, reddish, and even dirty violet-colour; but whatever its colour, its powder is always grey; its fracture is vitreous and its aspect greasy. It dissolves, but does not effervesce, in nitric acid. It is reducible by the blow-pipe with the addition of a little potash. It is generally translucent, and its specific gravity is 6·9. It consists of about 60 to 80 per cent. of oxide of lead and 19 or 18 of phosphoric acid, and a small quantity of muriatic acid. It occurs in hexagonal prisms, sometimes truncated, and sometimes surmounted by a pyramid, also botryoidal, reniform, and massive, and often barrel-shaped.

This is not a common mineral, and when found, it is usually accompanying Galena, in primitive mountains.

Arseniate of Lead.—This, rather a rare mineral, is interesting from the beauty of some of the specimens. It occurs in prismatic crystals of various shades of yellow, passing into hyacinth and aurora-red, and sometimes very brilliant. The crystals are semitransparent, and occasionally grouped together in a very agreeable manner. It occurs at Caldbeck Fell, in Cumberland, and at Leadhills in Scotland, where it is remarkable for the richness of its colour and the beauty of its crystalline forms. It is also found in various places, mammillated and reniform, and in others, filamentous and capillary.

Chromate of Lead.—This is a very beautiful and exceedingly rare mineral. It occurs crystallized in four-sided prisms, striated longitudinally and with terminal pyramids. Its colour is a magnificent scarlet (which, however, changes with exposure), and it is translucid. Its powder is yellow. It colours glass of borax green, and is soluble without effervescence in nitric acid, colouring the solution yellow. Its specific gravity is from 5·9 to 6·6, and it contains from 64 to 68 per cent. of oxide of lead; the rest being chromic acid. Its principal locality is the gold-mines of Berezoff, in Siberia; but it is said to occur also in Brazil. Humboldt discovered a brown Chromate of Lead at Zimmapan, in Mexico, containing 69 per cent. of lead.

Molybdate of Lead rarely occurs massive; it it is generally crystallized in octahedrons or square prisms, and modifications of these; or in octagonal tables stuck up on their edges. The colour is a dirty Isabella-yellow, wax-yellow, grey, brown, orange-, and aurora-red. Before the blow-pipe it fuses into

a grey mass, in which globules of lead are visible; with borax it forms a bluish-white glass; it is soluble in nitric acid, but with difficulty, and leaves a residue. Its specific gravity is from 6·69 to 6·76. It occurs chiefly in calcareous gangues, and is met with in different places along with the ores of Lead. It is composed of from 60 to 64 per cent. of oxide of Lead, the rest being molybdic acid. This mineral exists in such small quantity as to be of no importance.

Such, then, are the principal ores of Lead, of all which the sulphuret is the only one, as I have before observed to you, that is smelted; the others, when they occur along with it, are also smelted, but are of no importance by themselves. They are individually too rich to be wasted, and are accordingly worth smelting when found, in order to increase the product arising from the reduction of the sulphuret.

Lead, as I have said, is extensively distributed, so that almost every country possesses a greater or less quantity for its own consumption, and some even in sufficient quantity to export to those who have not a sufficiency. England now exports about 14,000 tons; we formerly exported a great deal more, but Spain, which has discovered and smelted Lead to a large amount, has driven us in part out of the foreign market. The quantity produced by Great Britain annually is about 48,000 tons, obtained chiefly from the sulphuret. The metallurgical processes for the reduction of the metal are rather complex.

The uses of Lead are far too numerous to be detailed; I will however mention a few. A very great quantity of this metal is converted by rolling

into what is called sheet or milled Lead. Lead in sheets was anciently used for writing on; thus, Hesiod, according to Pausanius, wrote seven of his books on sheets of Lead; and Pliny tells us that public acts were preserved on plates of Lead. Hertius, when besieged in Modena, wrote an account of his situation to Decius Brutus on sheet lead, and the latter replied by the same means. This material was used by the Romans as we now use sheet-copper, for sheathing the hulls of their vessels. At present it is applied to the covering of roofs. You have no doubt heard of the "Leads of Venice." These are prisons so called, in the Palace of St. Mark, that are immediately under the roofs, which being covered with Lead are insupportably hot. Sheet Lead is also used for coffins, and a variety of other purposes. When exceedingly thin, it is employed for lining tea-chests and other objects.

Leaden pipes for the conveyance of water were early known, and are still used to an enormous amount. In some special cases, the extent to which they have been applied has been very great: thus it has been calculated that the leaden pipes by which Hampton-Court Palace is supplied with water from Coombe Wood, and which were laid down by Cardinal Wolsey, weigh 1,065,000 lbs. The whole of the Palace also, which is very extensive, is covered with Lead. Nor is Lead used for pipes alone; the great bulk of our water-tanks are made of it, a practice which should be discouraged, as an oxide of Lead is formed at the water-line, which, if taken into the system, is highly prejudicial. Tanks of slate are greatly to be preferred, and a sub-

stitute for leaden conduit-pipes is also much to be desired.

The gutters and pipes for conveying the rain from our house-tops are also of Lead; and the quantity of metal employed for this purpose alone in our cities is immense.

Lead was formerly very extensively used for the framing of window-glass, both in churches and dwelling-houses, and is still employed for that purpose to a considerable extent; none but the very best Lead is fit for this object. The dishes or beds of cyder-presses were formerly of Lead, and the same metal was used for dairy purposes, in both cases prejudicially to health, as the malic acid in the former, and the sour milk in the latter, unite with the Lead and form a very strong poison. The dangerous effects of Lead upon the constitution of those who work at the several preparations of the oxides of this metal, are well known. It produces a kind of palsy and violent cholic, called the *painters' cholic.*

Lead has been used by the Romans for coins—and there is no doubt but that statues were occasionally cast of it; but they are very rare, having probably been melted down.

Pieces of Lead are affixed to goods and then stamped, to signify their having paid certain dues, or that they are permitted to pass.

Lead, as well as iron and bronze, is used for purposes of war, and the quantity cast into bullets for muskets, pistols, and carabines, is very great. A much larger quantity than you would suppose is also converted into shot for the use of the sportsman.

These shot are of Lead with a small admixture of arsenic. The melted metal is poured into an iron vessel perforated with holes of the required size, and falls like rain-drops through a distance of 130 feet into a vessel of water beneath; they become round in the descent. The shot afterwards go through other processes, the object of which is to separate the good from the bad, and to give them that black polish they have in the market. You may have observed on the Surrey side of the Thames two or three high towers, these are shot-towers. The present process of shot-making is said to have been the result of a dream. The lucky dreamer took out a patent which he sold for £10,000; a large sum, which he had not the sense to employ to good account, but expended in a foolish building speculation at Clifton, where his edifices, long uncompleted, went by the name of Watts's Folly. In a single one of the shot-towers of London, five tons of shot are made in a day; but how many days in the year they work I cannot say.

Lead is used in what is called *Ley Pewter*, which contains at least 20 per cent. of it, the rest being tin.

The red oxide of Lead, or *Minium*, is used in the manufacture of certain kinds of glass, for rendering it more fusible, and increasing its density and refracting power: too great a quantity, however, renders the glass yellow.

Minium is also used as a pigment, and is one of the colours of your box, under the name of *Red Lead*. The yellow oxide, or *Massicot*, is another useful pigment. *Ceruse*, or White-lead, which is a carbonate,

is likewise employed in house-painting, and for putty and other purposes. *Litharge*, again, is another preparation of Lead, valuable in the arts.

The *Sulphuret of Lead* is used for giving the glaze to common pottery, for which purpose an immense quantity is annually employed.

The same ore of lead is used with lamp-black by the women of the East for their eyebrows and eyelashes.

The *Chromate of Lead* is occasionally employed by the Russian painters as a pigment.

Lead alloyed with antimony, and sometimes with arsenic, is used for printing types; an article to which the civilization of the world is so much indebted.

The *Acetate of Lead*, or salt of Saturn, or sugar of lead, is prepared from litharge; it is much used for calico-printing, and also in surgery.

NICKEL is a rather rare metal; when purified, it is silver-white, very malleable and tenacious, as it may be rolled into plates of the 500th of an inch in thickness, and drawn into wire of the 50th of an inch in diameter. It is unalterable by exposure to the air, and is extremely difficult to melt. Its specific gravity, after being forged, is 8·66. In common with iron, it acquires magnetic polarity; its pure oxide is a beautiful green.

The most abundant ore of this metal, the Sulphuret of Nickel, which is generally a compound of nickel, arsenic, and sulphuret of iron, is of a pale copper-colour, and has not yet been found crystallized. It is hard enough to give fire with steel, and emits, when struck, the garlic-like odour that indicates the presence of arsenic. Its specific gravity

is about 6·6. It is found in veins in primitive rocks, and usually associated with cobalt, silver, and copper. It occurs in Saxony, in Bohemia, in France, and at Ewe, in Cornwall; is usually massive, but is also met with botryoidal, reniform, dendritic, and reticulated. It contains from 44 to 48 per cent. of Nickel. This mineral is sometimes coated with a fine apple-green crust called *Nickel-Ochre.*

Pimelite, or *Oxide of Nickel*, is also of an apple-green colour. It is found investing other minerals in the manner of the ochre just mentioned; but differs from it in its composition. It occurs in Silesia, in veins of serpentine, and associated with chrysoprase, of which it is supposed to be the colouring matter.

Since the manufacture of German silver, into the composition of which Nickel enters, this metal has become of some importance, and is now extracted to a considerable extent, particularly from the cobalt ores.

When thirteen parts of Nickel are alloyed with thirty parts of copper, it forms what is called by jewellers *Petit-Or*, which very nearly resembles gold.

The oxides of Nickel give a delicate grass-green colour to porcelain, and a hyacinth-colour to glass.

Nickel is employed by the Chinese in the manufacture of that beautiful metal called White Copper. It is also used as an alloy with iron by our Birmingham manufacturers in various useful ways.

Magnetic needles have been made of Nickel, which possess the great advantage of not being affected by the moisture of the atmosphere.

It is very remarkable that all the meteoric iron which has hitherto been found is alloyed with Nickel.

This metal was not known to the alchemists, and is not therefore placed under the influence of any of the old divinities.

LETTER XXIX.

Zinc—Calamine—Blende—Tutenag—Bismuth—Sulphuret of Bismuth—Oxide of Bismuth—Bismuth Blende—Needle-Ore—Fusible Metal—Antimony—Sulphuret of Antimony—Red Antimony—Crude Antimony—Manganese—Pyrolusite—Grey Oxide of Manganese—Black-wad—Siliciferous Oxide of Manganese.

IT is a great satisfaction to me, dear Florence, to find that your interest in these letters does not flag, notwithstanding that, in treating of the metals, I am unable to enliven the subject. It is true, the great importance of these productions is sufficient of itself to excite the curiosity of an inquiring mind; and I certainly ought to have known you better than to fear you could find any thing dry and unentertaining, that could increase the amount of rational knowledge you already possess. Encouraged therefore by the zeal and aptitude of my pretty pupil, I shall continue my lessons, and will begin this letter with an account of Zinc.

ZINC, or *Spelter*, is a bluish-white metal, of a lamellar structure, and considerable brilliancy when freshly broken; but it speedily tarnishes on exposure to the air. It possesses some very singular properties: thus it has little cohesion till it has been subjected to a process of lamination at a temperature of from 200 to 300^0 F., after which it is found to have become malleable and ductile, and to retain these qualities. It is also remarkable that, when heated to 400^0, it may be reduced to powder in a mortar, not otherwise. It melts at 680^0. It readily burns

with a greenish-blue flame; and such is its avidity for oxygen, that when burning, it flies up in the form of white flakes, called *flowers of zinc*, or *philosophical wool.* Its specific gravity is 6·86, but when it has been hammered it is 7·19.

This metal, one of the most abundant in nature except iron, is not found native, nor are its ores numerous; they present, however, such diversity of aspect, that it is difficult for any but a mineralogist to recognize them. The two ores of Zinc are the Oxide and the Sulphuret.

Calamine is the name which may be, and indeed is, by some mineralogists, given indifferently to the oxide and to the carbonate of Zinc, as these two so insensibly pass into each other as to form properly but one species. The colours of this mineral are a pale yellowish-grey, passing into darker shades of the same, also various shades of green and brown. It is found crystallized, compact, stalactitic, mammillated, botryoidal, corroded, pseudo-morphous, and earthy. It is infusible without addition before the blow-pipe. The pure oxide does not effervesce with acids, but those varieties that contain carbonic acid do; the siliceous oxide becomes electric by heat; the smallest particle of it, being rubbed, attracts light bodies, as sealing-wax does when rubbed; the carbonate does not possess this quality, neither does it form a jelly with the acids, as the siliceous oxide does.

Calamine is found in China, in Siberia, the United States, Hungary, Carinthia, Silesia, and France; also in our own country, as at Mendip, in Somersetshire; Matlock, in Derbyshire; Wanlock-

head and Lead Hills, in Scotland; and other places. One of its chief European repositories is the Duchy of Limbourg, in the Netherlands; where about 1,500,000 lbs. of the ore are annually extracted.

Calamine belongs more particularly to rocks of secondary formation, but is often found as an accompaniment of lead, in veins of this metal, in different kinds of rocks.

Phillips tells us, the name Calamine is derived from the latin *Calamus*, a reed, for when in fusion, it adheres to the base of the furnace in the form of reeds.

The red oxide of Zinc, of which some specimens are exceedingly beautiful, is a compound of from 88 to 92 of oxide of Zinc, and from 12 to 8 of oxide of iron and manganese. The siliceous oxide, of which also there are some beautiful varieties, contains from 64 to 66·83 of oxide of Zinc, the rest being silica and water. The carbonate is formed of from 62·5 to 65·5 of oxide of Zinc, the rest being carbonic acid.

Blende, or the *Sulphuret of Zinc*, called by the miners *Black Jack*, was till recently employed in Wales for mending the roads. The colours of this ore are brown, yellow, blackish-brown, red, and black; rarely green. It occurs both crystallized and amorphous. The forms of the crystals are very various, derived from the rhombic dodecahedron. It is translucent or opaque; yields to the knife; the streak varies from white to reddish-brown; it is easily broken, and the fracture is splendent. Its specific gravity is from 4 to 4·2. It contains from 50 to 62 per cent. of Zinc, the rest being sulphur with a small quantity of iron. The dark-coloured crystalline

varieties are principally from Derbyshire, Cumberland, and Cornwall; it occurs also in Transylvania, Hungary, and the Hartz. A transparent bright-yellow variety is found at Kapnik, at Baygorry, in France, and in the Higher Pyrenees, which is phosphorescent by the slightest friction; and a still more brilliant variety, of an oil-green colour, occurs at Schemnitz; while Sahlo in Sweden, Ratieborgitz in Bohemia, and several of the Saxon localities, are celebrated for the splendid brown and black crystals which they afford.

This ore of Zinc is almost always found in veins in primitive mountains, and in the compact lime-stone of secondary formations, and associated with the ores of other metals: it seldom occurs alone.

Zinc was for a long time disregarded, except to be thrown away, as its presence was considered prejudicial to the metallurgical processes of those ores of lead, &c., with which it was mixed. Calamine, however, was used for the making of brass, which is an alloy of Zinc and Copper, long before the pure metal or spelter was found to be available for the purposes to which it is now applied. For, as I have said, it is neither malleable nor tenacious till it has undergone the process of lamination at a considerable heat; a fact very recently discovered. Zinc is now placed as the sixth metal in order of facility for drawing into wire, and the eighth in the order of those that may be rolled out into sheets. A zinc-wire of one-tenth of an inch in diameter will bear a weight of twenty-six pounds.

The uses to which Zinc is now applied are many and important. As it is harder and lighter than lead,

it is advantageously employed for tanks, pipes, baths, and a variety of other purposes. On exposure to air and moisture, it becomes covered with a grey coating, which is a sub-oxide, but which when formed protects the metal from further oxidation.

Sheets of Zinc have been recommended for sheathing ships' bottoms. It is sometimes used for roofing; but its combustibility is a great drawback to its extensive employment in this way; very thin leaves of Zinc will take fire with the flame of a taper.

It has been observed, that zinc-pails or dishes used in the dairy, cause the milk to give out a very much greater quantity of cream than can be otherwise obtained; but the milk that remains is unwholesome, and not fit for human food; pigs may be fed on it with impunity.

Zinc will ever be interesting as connected with the galvanic battery, an apparatus which has of late, in the hands of philosophers, opened out a most wonderful field of discovery in the hitherto occult operations of nature.

A very important application of Zinc has recently been made in coating with it sheet iron, by which this latter metal is effectually preserved from rust.

Zinc is common in China, under the name of *Tutenag*. It is employed chiefly as an alloy; but the Chinese also use it for current coin; the pieces having a Tartar inscription on one side, with Chinese characters on the other, and a square hole in the centre for the purpose of stringing them.

The chief use of Zinc, however, is for the production of brass, the applications of which are far too

numerous to be detailed, and some of which have been already mentioned in my letter on Copper.

The oxide of Zinc obtained by sublimation is used in medicine. *Sulphate of Zinc,* or *White Vitriol,* is used in the preparation of drying oils and varnishes: it occurs native, but that of commerce is an artificial production.

A white pigment is also prepared from Zinc, which is used to advantage in house-painting, and is said to be less liable to change than white-lead.

The annual consumption of Zinc in this country is between twenty-five and twenty-six thousand cwt. A good deal is imported by us, and re-exported to the East. According to McCulloch, in the three years ending with 1828, 126,320 cwt. were exported from British ports, the declared value of which was £95,000.

BISMUTH.—Of this metal, which is very scarce, there occurs three varieties, the native, the sulphuret, and the oxide; and of these, the first is the most common. Its colour is a yellowish-white, not unfrequently tarnished externally. It occurs feathery, reticulated, amorphous, and crystallized in the form of the regular octahedron. It has a metallic lustre and lamellar structure; it is ductile, and, when cold, brittle; but if heated, it may be hammered into plates. It melts at the flame of a taper. After fusion, if it be allowed to cool gradually, it crystallizes in regular cubes prettily marked. Before the blow-pipe it volatilizes in the form of a white powder; its specific gravity is from 9·0 to 9·8.

Native Bismuth is found in various places. At Schneeberg, in Saxony, it occurs in the dendritic form,

in a reddish-brown jasper, giving the mass, when cut into slabs and polished, a very pretty appearance; also in large plates that are irised. This mineral is perhaps never perfectly pure, as it generally contains a little cobalt and a little arsenic. It occurs in veins in primitive rocks in a few localities on the European continent, also in Cornwall.

Sulphuret of Bismuth.—This variety is scarce, and difficult to characterize; it varies in colour, being sometimes yellowish-white, sometimes tin-white or lead-grey. It occurs in acicular prisms and minute crystals, deeply striated longitudinally; also massive, with a foliated structure like galena, or a fibrous one like antimony; it is soft and brittle, and melts, like the native metal, at the flame of a candle. Both this and the preceding species are soluble in nitric acid, and the solution yields a white precipitate when farther diluted.

Its localities are pretty much the same as those of Native Bismuth. It consists of 60 per cent. of Bismuth, the rest being sulphur.

Oxide of Bismuth.—This is either compact or in the state of a powdery efflorescence on the surface of Native Bismuth, and is accordingly found in the same localities with the latter. Its colour is straw-yellow, yellowish-green, and yellowish-grey. It occurs in very small quantity, and is of no importance. There is also a *Bismuth Blende*, which is found in Saxony; it contains about 69 per cent. of the oxide of Bismuth. Its general appearance is that of implanted globules about the size of a pin's head, and of a dark brown colour.

Lastly, we have a compound mineral, called

Needle-ore, which contains about three per cent. of Bismuth, besides sulphur, lead, copper, nickel, and tellurium. It is also called *Plumbo-Cupriferous Sulphuret of Bismuth.* It is a rare mineral, found near Ekaterineburg in Siberia, accompanying galena and gold. It is imbedded in quartz in the form of acicular four- or six-sided prisms, longitudinally striated. These needles lie in all directions and cross each other, and where several meet they form a small mass. It is not turned to any account. The principal localities of Bismuth are Schneeberg and Freyberg, in Saxony, which furnish annually from 40 to 50 cwt.

Bismuth is by no means abundant; it is a much rarer metal than gold, and yet its price is very inferior, by reason of its few valuable qualities and the little comparative use that can be made of it: nevertheless it is employed in the composition of alloys for printers' types, for pewter, and solder.

With eight parts of Bismuth, five of lead, and three of tin, a fusible metal is obtained of a bright pewter-colour, that melts with the heat of boiling water. Tea-spoons have been made of it in order to create surprise; for on putting one of these spoons into a cup of hot tea, it immediately melts and disappears. But a much more interesting use has been made of this fusible alloy. It has been employed for injecting the numerous ramifications of the trachea. The animal matter being subsequently destroyed, there remains the arborescent representation of this part of the human structure. Such are occasionally seen in surgical cabinets.

Bismuth is also employed for the silvering, if we

may so call it, of glass globes, of certain concave mirrors, and of reflectors cut into facets.

The white powder which is precipitated from the solution of Bismuth in nitric acid, was once used by ladies, under the name of pearl-white, for beautifying the skin; but some of their faces suddenly assuming a lead colour upon approaching too near the fire, they became so dreadfully alarmed as soon to renounce a cosmetic which exposed them to such unexpected mortification.

By writing with the colourless solution of Bismuth, nothing is seen till the paper be plunged into water, when the letters become white and perfectly legible.

It is said that pomatum prepared with the oxide of Bismuth will turn the hair black.

ANTIMONY is a silvery white metal, with a bluish tinge and lamellar structure; it is easily melted by the blow-pipe, and forms a white oxide, which gives a yellow colour to glass; it dissolves in nitric acid, and its specific gravity is 6·7. Nature presents us with this metal in four different states—native, the oxide, the sulphuret, and the hydrosulphuret. Of the third and fourth of these there are different varieties. The native metal is very rare; there is one variety of it which contains a small portion of arsenic. It has all the characters of the Antimony of commerce; it occurs in the Hartz, and at Allemont, near Grenoble, in France.

The oxide is of a pearl-white or yellowish-white, with a lamellar structure. It occasionally assumes the prismatic form, and is always very friable; before the blow-pipe it decrepitates, and is then volatilized,

and sometimes melted. It usually accompanies sulphuretted Antimony, which indeed seems to pass into it, as, notwithstanding its colour and aspect, it preserves the prismatic form of the sulphuret, which is sometimes observed with its proper brilliancy in the interior of the oxide.

Both the native metal and the oxide are rare, nor are they of any consequence; accordingly, they are collected only as specimens for cabinets.

SULPHURET OF ANTIMONY, or *Grey Antimony Ore.*—This is the ore from which alone the metal is obtained; it is of a light lead-grey colour and metallic brilliancy, but sometimes dull externally and often beautifully iridescent. It occurs massive, disseminated, and crystallized in rhombic prisms, variously modified and terminated; its general appearance, however, is that of a mass of parallel and sometimes diverging needles, separated at their extremities. It is brittle, yielding to the pressure of the nail, and makes a black mark upon paper. It melts in the flame of a candle, contains from 73 to 75 per cent. of Antimony, the rest being sulphur; and its specific gravity is from 4·3 to 4·6.

It is found in thick veins in primitive and secondary rocks, with the exception of trap and serpentine. It is a very abundant mineral, and if its applications were more numerous than they are, it would be more extensively worked. Its principal mines are in France and Hungary; the former country producing about half a million of pounds yearly. It occurs also in Spain, in England and Scotland, and elsewhere.

The HYDROSULPHURET, or *Red Antimony.*—It

occurs in acicular crystals, often diverging or interlaced, and also amorphous; the former of a dark or cherry-red by reflected, and of a crimson colour by transmitted light; but is frequently tarnished of a brown or bluish tinge, or is iridescent; the lustre is adamantine; it is feebly translucent and brittle. The massive variety is of a dead brick-colour, sometimes yellow. Both varieties are found at Braunsdorf, in Saxony, and a few other localities: they consist of about 67 per cent. of Antimony.

Antimony is sold in rounded lumps, the surface of which is marked by a branching star, whose rays much resemble a fern-leaf. This is a phenomenon of crystallization common also to some other metals, but in none so marked as in Antimony.

This metal has the property of hardening the soft metals with which it is alloyed. Its chief use is in the composition of printers' types, but it is likewise employed in alloys for other objects.

It enters into the composition of fireworks, and its yellow oxide is used for enamel and porcelain-painting.

It affords also very effective medicinal preparations, which, however, are too dangerous to be taken but as ordered by experienced practitioners.

It would appear that the star of which I have spoken, pointed out this metal to the superstitious imagination of the alchemists, as a most important material for their great work, and accordingly none has been submitted to more experiments than Antimony.

What is called *Crude Antimony* is obtained by the most simple of metallurgical processes; but as this

contains sulphur, it has to undergo two or three other simple operations in order to obtain the pure metal.

There is a curious fact regarding Antimony, viz. that if it be ground to a fine powder and thrown into a dry glass-jar filled with chlorine, it will inflame, and continue to burn with great rapidity and with a brilliant white flame, affording a very beautiful spectacle.

MANGANESE is a metal which has such a strong affinity for oxygen that it is never found in the state of a regulus. When obtained from its ores, which can be effected only by intense heat in closed vessels, it is found to be of a greyish-white, brilliant, very hard and brittle, and having a fine-grained fracture: its specific gravity is given so differently by different authors, that it is doubtful whether it has yet been correctly ascertained.

There are eight or nine different ores of Manganese, which present very dissimilar appearances; but they have all one common chemical character by which they may be known,—reduced by the blow-pipe with borax and an alkali, they all colour the glass bead of an amethystine tint.

PYROLUSITE, or *Metalloide Oxide of Manganese*, contains from 82 to 84 per cent. of the Red Oxide of Manganese. Its colour is generally iron-black, but it is sometimes silvery-white: its lustre is metallic; it effervesces briskly in borax before the blow-pipe.

This is the most common ore of Manganese, and is accordingly that which is most generally employed. Great quantities are found near Tavistock, in Devonshire, and Launceston, in Cornwall. It is also abundant in Thuringia; and the mines of Ehrensdorf, in

Moravia, afford annually many hundred tons of it. It occurs likewise in Saxony, Hungary, France, and other places.

Grey Oxide of Manganese is the most beautiful and the purest of the ores of this metal: it contains from 86·41 to 86·85 of the Red Oxide, and its specific gravity is from 4·31 to 4·4. The colour of this ore is steel-grey, passing into iron-black; it occurs in prismatic crystals, and also in acicular crystals longitudinally striated, either diverging or confusedly intersecting each other; also massive with a fibrous structure; its lustre is imperfectly metallic; it is opaque, marks strongly when rubbed, giving a dark reddish-brown, and in the massive varieties a black streak. It is infusible without addition. This substance occurs in both primitive and secondary formations, in veins, beds, and irregular masses. Its principal locality is Ihlefeld, in the Hartz; but is found also in other countries, including Scotland and England.

Black-Wad.—This is an old English name for the *Hydrated Peroxide of Manganese.* It occurs in various shapes and coating other minerals. It is brown of various shades, both externally and in the streak; is opaque, very sectile, and soils. Its specific gravity is about 3·7. The principal localities of Black-Wad are Cornwall and Devonshire, the Hartz, and Piedmont.

Siliciferous Oxide of Manganese, or *Lithoide Manganese,* is of a pale rose or peach-blossom colour, but sometimes white or yellow; it scratches glass; has an uneven, scaly, and sometimes lamellar structure; and is slightly tranlucent on the edges. It resembles marble much more than a metallic ore. The

white variety is found at Kapnik, in Transylvania; the rose-red in New Jersey, in Sweden, in Siberia, and the Hartz; also at Black Down, near Tavistock, in Devonshire, and near Collington, in Cornwall.

Manganese is a very extensively distributed metal; for besides its own ores, it enters into the composition of many of the ores of other metals, and in that of a great variety of stones, and, like iron, is found in some animal and vegetable substances.

The Oxides of Manganese are most useful minerals, from which, however, the metal is never extracted; they being used in their natural state. From them chlorine gas is obtained, the value of which for disinfecting hospitals, prisons, &c. is justly appreciated. Another important use of chlorine is in the preparation of bleaching liquors. But the most extensive application of the Oxide of Manganese is in the manufacture of flint glass, where it is used for the purpose of destroying the yellow colour of the glass, and rendering it clear and bright. For this object, it must be very pure, and free from any admixture of iron; and if too great a quantity be introduced into the glass, this acquires a lilac tint, as may be observed in some of the houses of the aristocracy in the West-end of London.

The Peroxide is used in the preparation of coloured glass pastes, in imitation of precious stones, and also for giving a black varnish to pottery.

In porcelain-painting, Manganese is employed to give a fine brown or lustre ground-colour.

The Black-Wad has this remarkable property, that if it be powdered and mixed into a dough with linseed-oil, it spontaneously inflames.

The Sulphate of Manganese, which is occasionally found native, but is artificially prepared, is used in calico-printing for giving a chocolate or bronze-coloured impression.

The rose-coloured *Siliciferous Oxide* is a very pretty substance, having its peach-blossom colour varied with black spots and bands; and as it takes a pretty good polish, it is cut and worked into tablets, boxes, and a variety of similar objects. It is greatly prized in Russia. M. de Dree had a vase of it, six inches high and four inches in diameter, of a fine pink colour, chequered with black, which was sold for 253 francs.

A pomatum is prepared with Manganese which is very useful in cutaneous diseases.

I will now conclude this letter with the following extract from Parkes's *Chemical Catechism*:—

"If one part of the black oxide of Manganese and three parts of the nitrate of potash, both reduced to powder, be mixed together and thrown into a red-hot crucible and continued there until no more oxygen gas is disengaged, a greenish friable powder is obtained, called *mineral cameleon*, from its property of changing colour during its solution in water. If a small quantity of this powder be put into a glass of water, the solution is first *blue;* oxide of iron then separates, and by its *yellow* colour renders the fluid *green:* this subsiding, the *blue* re-appears; then, as the oxide of Manganese absorbs oxygen from the atmosphere, it becomes *reddish*, *brownish*, aud at last *black*. It then subsides, and leaves the fluid *colourless*. Again, if *hot* water be poured upon this singular substance, a beautiful *green* solution will be produced, whereas

cold water will give one of a deep *purple.* These changes depend upon the various states of oxydizement which the metal acquires by change of temperature. In the first formation of this compound, care should be taken that no sulphur comes in contact with it; as the addition of a very small portion of sulphuret of potash would counteract its effects."

This substance affords an admirable proof of the fact, that what often appears very surprizing to the ignorant, is most easily accounted for by the well informed, upon the most simple and natural principles. But I must now conclude: I have yet two or three more metals to speak of, after which I will change the subject.

LETTER XXX.

Cobalt — Arsenical Cobalt — Bright White Cobalt — Cobalt Bloom—Zaffre and Smalt—Arsenic—Native Arsenic—Oxide of Arsenic—Sulphuret of Arsenic—Realgar—Orpiment—Chrome.

I AM very glad, dear Cousin, to learn that your intended excursion is postponed for a little longer, as I know from experience, that interruption in lessons, no matter on what subject, is always attended with disadvantage to the learner. It is very true that these letters are not so necessarily connected that each may not be understood by itself; but I should be sorry that your attention were drawn off till you shall have had before you the entire sketch of the whole subject, as I originally intended to present it to you. When, upon concluding these lessons, you will have acquired a notion of the extent of the subject and the objects it embraces, you may then keep my letters for future reference on any particular point, or select from them any special branch of the subject which you may feel inclined to study more in detail. Should your trip have been undertaken before our subject was concluded, it would be doubtful whether you could again take it up, at least for some time, and then the impression of it as a whole would be less perfect. I rejoice, therefore, as I have said, that we can proceed without fear of interruption. I have now to treat of three more metals—Cobalt, Arsenic, and Chrome.

Cobalt is a metal that possesses a striking pro-

perty by which it may be easily recognized, whatever appearance it assumes. It communicates a very beautiful and pure blue colour to glass. The metal itself resembles tin in colour, but is not brilliant. It is hard and brittle, and has a fine close grain; by long exposure to the air, it acquires a violet tint. Its specific gravity is 8·538. Cobalt is, next to platinum, the most difficult to melt of all the metals. Like iron and nickel, it has magnetic properties. The pure metal has never been found in the native state. There are several ores of it, of which I shall mention only the principal.

Arsenical Cobalt.—This mineral is of a tin-white colour, inclining, when massive, to steel-grey: its surface acquires a violet tinge after exposure to the air; its fracture is fine and close grained, and it yields with difficulty to the knife; upon exposure to the flame of a candle it gives out an abundant white smoke and strong garlic-like odour. Plunged into nitric acid it immediately effervesces briskly, and affords a pink solution. It colours glass of borax and other fluxes of a fine deep blue. Its specific gravity is from 6·4 to 7·7. The form of its crystals is cubical or octahedral; but it occurs also arborescent, reticulated, botryoidal, stalactitic, and amorphous. It is found in Spain, France, Saxony, Bohemia, and Suabia, and Cornwall; but is far from being an abundant mineral; it contains from 20 to 28 per cent. of Cobalt, and about three times as much Arsenic.

Bright White Cobalt is of a silver- or yellowish-white colour with a tinge of red; it strikes fire with steel, and then gives out the garlic smell, as it likewise does before the blow-pipe. Its crystals resemble

in form those of iron pyrites; but it occurs also in various other forms like the arsenical Cobalt, which it greatly resembles in its general appearance, and from which it differs chiefly in its structure, this being very sensibly lamellar. Its specific gravity is from 6·23 to 6·45, and it contains from 33 to 44 per cent. of Cobalt. This species is remarkable for the size, perfection, and brilliancy of its crystals. Its principal locality is Tunaberg, in Sweden. There are also *Oxides of Cobalt* of different colours and appearances, but usually black, or brown and earthy.

COBALT BLOOM is remarkable for its colour, which is *peach-blossom* red, a colour peculiar to this substance, and belonging to no other mineral; it occurs, nevertheless, of other colours, as crimson, greyish-white, and even green. It is found in botryoidal masses, and short acicular diverging crystals, whose red tints are particularly brilliant by strong reflected light. When crushed in a dry state, the powder possesses a lavender-tinge, which is not the case when moistened. Like all the ores of Cobalt, it colours glass of borax blue. It is soluble in nitric acid, which it colours red. This is one of the most widely-distributed ores of Cobalt; but as it never occurs in any quantity, it is of no importance.

The ores of Cobalt belong chiefly to the primary rocks, and among these, to those that are stratified.

Metallic Cobalt is never extracted from the ores but as an object of curiosity; and of its ores, the Arsenical and Bright White, or, as the latter is sometimes called, the Grey, are the only two that are worked.

The principal use of Cobalt is for the preparation

of *Zaffre* and *Smalt*. In order to obtain the former, the ore is submitted to a process by which the arsenic and sulphur it contains are driven off; it is next mixed with siliceous sand, and the two are ground together; and then moistened and made up into masses, in which state it is sent from the place of production to various parts of the world.

From the Zaffre, Smalt is thus prepared. The Zaffre being mixed with a certain portion of potash, the whole is melted together in crucibles; the result is a glass of an intense blue colour approaching to black. This glass, as it is formed, is ladled out and thrown into tubs of cold water, where it flies into pieces, forming a kind of angular gravel; this is then ground into powder, which is subsequently separated into Smalt of different degrees of fineness, by a process similar to that I have described to you when speaking of Emery. In Sweden, however, the process is said to have been improved, but it is more complicated.

The uses of Smalt are extensive: it is employed in the dressing of linen, cambric, muslins, thread, &c.; giving them that delicate bluish tinge which is generally preferred to crude white. It is, in like manner, employed for a similar purpose in writing-paper, an object, however, which is greatly dependent on individual taste and general fashion. Some prefer a yellowish or cream-coloured paper, others a bluish paper; at one time all papers were yellowish, then the blue tinge came into fashion, and now again the cream-colour is coming into vogue.

The blue tinge of starch is given to it by Cobalt, and the powder and stone-blue of the laundresses are Smalt.

Smalt-blue is also much used as a pigment in house-painting, and for sign-boards, &c. A great deal is also employed for giving a blue colour to glass, and for enamel and porcelain-painting and for earthenware. The fine blue colour of finger-glasses, of hyacinth-glasses, &c., is given to these and similar objects by Zaffre and Smalt; substances which appear also to have been employed for the rich blue glass of old gothic windows. Five grains of Cobalt are sufficient to give a blue colour to a ton of glass.

It would appear, indeed, that the preparation of the Oxide of Cobalt was known to the ancients, as cubes of enamel, coloured by Cobalt, are found in old Roman mosaics, and the blue used by the Egyptians in the painting of their mummies has also been found to be Cobalt. The knowledge of the use of Cobalt was, however, again lost, and not re-discovered till the sixteenth century, previous to which the ores of this metal were considered by the miners not only as useless, but troublesome when found among other ores, and that to such a degree, according to Beckmann, that a prayer was used in the German Church that God would preserve miners from *Kobolts* and from evil spirits. At present, the Cobalt ores of Hessia produce a net profit of £14,000. Tunaberg, in Sweden, is the locality of the purest ore.

The vitreous nature of Smalt-blue prevented, for a long time, its admission upon the pallet of the painter, till the celebrated French chemist, Thenard, discovered a means by which it might be employed, like other colours, with oil. The pigment thus prepared is known as *Thenard's Blue.* Before this discovery, when Cobalt was used in fresco-painting, it

could be fixed only by the addition of glue or some other mucilage. It rivals ultramarine in its brilliancy and durability.

France, though it has some mines of Cobalt of its own, imports Zaffre to the amount annually of 200,000 francs. England imports much less than she formerly did, since the discovery and working of her own deposits of Cobalt ore.

Finally, the muriate of Cobalt much diluted, forms an exceedingly pretty sympathetic ink. The writing is invisible when cold; but if the paper be brought near the fire, it becomes apparent, and of a beautiful green colour. It again vanishes on removal, so that the phenomenon may be exhibited several times, if the paper be not brought too near the heat. You may, dear Florence, amuse yourself, as others have done, by trying an interesting application of this. Draw a winter-landscape, with leafless trees and general absence of vegetation, in the ordinary way, then cover the trees, &c. with leaves by means of the sympathetic ink; having done this, your winter-scene becomes clothed with a brilliant summer vegetation on the approach of warmth, and the vegetation again vanishes as the picture is removed from the fire.

Arsenic.—This metal, of which we have all unfortunately heard too much as an active poison, exists in four different states, viz., Native, Oxydized, Sulphuretted, and combined, as a mineralizer in the same way as sulphur, with a variety of other metals, in the treatment of some of which it is collected as a valuable product.

Native Arsenic differs from the prepared metal

only by being less dense and more friable. The characters of both are, colour greyish black; aspect dull; tarnishes on exposure to the air; easily frangible; fracture fine-grained, uneven; texture curved or flat, lamellar, and sometimes slightly fibrous; yields to the knife; before the blow-pipe fuzes readily; burns with a bluish flame, and gives out a dense white vapour and strong garlic-like odour; acquires resinous electricity by friction. Specific gravity 5·76. Native Arsenic occurs reniform, botryoidal, and in flat masses, but has not been found crystallized. It exists chiefly in veins in primitive rocks, accompanying ores of silver, cobalt, and copper, in Saxony, Bohemia, the Hartz, Transylvania, Suabia, Siberia, France, &c. In the lower part of the silver mine of Zmeoff, in Siberia, it occurs in enormous large masses; and as these contain but a very small portion of silver, and the emanations from the mine were found to be very dangerous, it was judged expedient to close up this part of the mine as quickly as possible.

Oxide of Arsenic —Its colour is snow-white and transparent, perfectly volatile, and soluble in water. In some specimens the colour is accidentally soiled with a reddish, yellowish, or greenish tinge. It occurs earthy, capillary, investing other substances, in stalactites, and in tabular and prismatic crystals. It is soluble in hot water; when artificially sublimed it sometimes presents large distinct octahedral crystals. It is found in Hessia, Saxony, Hungary, Bohemia, the Spanish Pyrenees, &c.

Sulphuret of Arsenic.—Of this mineral there are two varieties, the red and the yellow.

Red Sulphuret of Arsenic, or *Realgar*, is of a very brilliant scarlet colour, generally translucent, but sometimes transparent. It occurs massive, disseminated, investing, acicular, and crystallized in a prismatic form. Its fracture is conchoidal with a splendent vitreous lustre; its streak is orange-yellow or aurora-red; it yields to the pressure of the nail; acquires resinous electricity by friction; burns with a pale yellow flame, and is volatilized, giving out a garlic and sulphureous odour; it loses its colour in nitric acid. Its specific gravity is from 3·3 to 3·6, and it contains from 69 to 75 per cent. of Arsenic. It occurs in primitive and transition rocks in Hungary, Transylvania, the Hartz, St. Gothard, Bohemia, and Saxony, and in minute crystals in the vicinity of active volcanoes, as the Solfatara, and at Vesuvius in the lava of 1794, as also on Ætna. It is likewise met with in the Solfatara of Guadaloupe, and in the volcanic region of Zimo in Japan, where it is in the form of stalactites. Mention is made of an opaque Realgar being found in voluminous masses near Kian Fou, five days' journey from Nankin, in China.

Yellow Sulphuret of Arsenic, or *Orpiment*.—This variety is of a very brilliant lemon-yellow or gold-yellow, whence its name; the streak is pale yellow. It occurs in much the same forms as the preceding variety, and exhibits similar characters; it very rarely occurs in minute crystals; the texture is generally foliated, sometimes fibrous, and the flakes are semitransparent and flexible, but not elastic; they are easily separated in the manner of talc or selinite. Orpiment is somewhat less fusible than Realgar. It occurs in Hungary, Transylvania, and other places in

Europe, and in several localities in the East. The Orpiment of commerce comes from the Levant.

Both the Sulphurets of Arsenic are beautiful minerals, and enliven by their brilliant colours the duller aspect of the substances with which they may be in contiguity in the cabinet.

Arsenic, as I have said, is but too well known as a violent poison; and the dreadful deaths occasioned by it, whether through accident or design, ought long ere this to have awakened the attention of Government to the necessity of either prohibiting the sale of this substance, except in particular cases, or enforcing the adoption of some means, such as have been lately recommended, of imparting to it a colour, and smell or taste, by which its presence may be immediately detected.

The antidote to this dreadful poison is vinegar, which mixed with water should be extensively administered. Its effect is to produce violent vomiting, by which the poison is ejected. The sulphuret of potash dissolved in water, (a few scruples dissolved in half a pint of water, and administered a little at a time, as the patient can bear it), has been recommended; its action is to neutralize the Arsenic. If ever any white powder be suspected to be Arsenic, or to contain an admixture of Arsenic, it is sufficient to throw a pinch of it on a red hot coal, in order to ascertain the fact; for if Arsenic be present, it immediately produces copious white fumes and a strong, pungent, garlic-like smell. It is better to be pestered with rats than run the risks occasioned by keeping Arsenic in the house for their destruction.

Arsenic in the metallic state is not used; even

that which is so found, is converted into an oxide for the purposes to which it is applied in the arts.

The greater part of the Arsenic that is used, is obtained from the roasting of arsenical cobalt and some other metallic ores. The process is considered so deleterious, that in some countries none are employed upon it but condemned criminals. The Saxon works produce annually to the amount of 60,000 francs' worth of Arsenic. The native Arsenic is also converted into the white oxide, or more properly *arsenious acid;* and the sulphurets, both native and artificial, are applied to many purposes.

Arsenic forms with copper a malleable and flexible metal that takes a fine polish, and is therefore employed for various objects that are designed to be plated. It is also used for speculum metal, for reflecting telescopes, and is likewise mixed with lead for making shot. It is the red sulphuret that is employed in the latter case, in the proportion of 20 lbs. of arsenic to 1,000 lbs. of lead: you need therefore be under no apprehension if you occasionally find a small shot in your mouth, when eating a slice from the breast of a pheasant.

Arsenic is occasionally employed in the manufacture of flint-glass, in order to purify it; but too large a proportion renders the glass milky.

The sulphurets, both red and yellow, are much used in calico-printing; and M. Braconnet has succeeded in fixing the beautiful and indestructible yellow colour of orpiment on tissues that are not to be washed, as velvets, paper-hangings, &c. Orpiment is also employed for staining white wood of a yellow tint, in imitation of box-wood.

Those beautiful pigments, *King's Yellow* and *Scheele's Green*, are both prepared from Arsenic; the former from Orpiment, and the latter being a mixture of Arsenic and oxide of copper.

Beautiful shades are said to be given to valuable furs by arsenical solutions.

In Turkey, a depilatory, called *Rusma*, is prepared from Arsenic.

In China, pagodas and similar ornamental objects are made of Realgar; besides which, it is fashioned into cups, in which acid vegetables are infused, to be used as cathartics.

Arsenic may be, and indeed is, used among ourselves in medicine. Thus according to Dr. Pearson, one-sixteenth part of a grain of white Arsenic is as harmless as a glass of wine, and, in that dose, is a remedy for intermittent agues. Its effect is so certain, that the French Directory once issued an edict, ordering the surgeons of the Italian army to free the numberless soldiers, who were seized with agues in the marshes of Lombardy, of the complaint, in the course of three or four days, under the penalty of military punishment. In the fens of England, arsenic is used in intermittent fevers.

Realgar and Orpiment are common remedies in Siberia for the intermittent fevers that are there so common. The mineralogist Patrin, after travelling for four years in that part of the Russian Empire, was attacked with the fever, and the persons around him endeavoured to persuade him to take their specific; but he says that, comparing their constitution with his own, he was convinced that what would take away their fevers would take away his life. It is

very true that the sulphuret is a less violent poison than the oxide, but it is still much too dangerous to be trifled with.

It is curious that while Arsenic has so dreadful an effect upon living bodies, it is a powerful antiseptic, and tends to preserve dead bodies from putrefaction, on which account partly it is employed in Taxidermy.

It has been recommended to saturate timber with an arsenical solution, particularly for ships, in order to secure them from the attacks of the worm, (*Teredo navalis*); but this method is by no means to be recommended, when we reflect that the timber of broken-up vessels is sold and used for fire-wood, the burning of which, in consequence of the arsenical fumes that would be then disengaged, would be attended with considerable danger. It is reported that a gardener and his family were all poisoned by eating bread that had been baked in an oven heated with the wood of an old trellice-work painted with Scheele's Green. But I must now pass on to another subject.

Chrome, or *Chromium*, from the Greek signifying *colour*. This metal is comparatively a very modern discovery. It has not been yet found isolated in nature, nor in the state of a pure oxide, nor as a sulphuret, nor in any combination of which it forms the basis; but is accidentally combined with several other bodies. Its great value, however, as a colouring substance, has led to its extraction from the minerals that contain it, particularly the chromate of iron, of which I have already spoken in my twenty-seventh letter. I have also mentioned the

beautiful chromate of lead in my twenty-eighth letter.

A siliciferous native oxide of Chrome was discovered, in 1809, in the department of Soane and Loire, in France. It occurs in thin, straggling veins, in a re-composed granite, which they traverse and cross in all directions. It is of a beautiful green colour; the best and richest in colour is pulverulent, from which state it passes gradually into a green quartz, fragments of which are found scattered about the soil and in the neighbouring ravines. A considerable quantity has been extracted from this locality, and has been treated, both at Paris and at Geneva, for the extraction of the chromic acid, for colouring glass and enamel of a green colour. It was found to contain sometimes as much as 10 per cent. of the oxide, but often less.

Chromium is chiefly used for the production of Chromate of potash, from which salt the various other preparations of this metal used in the arts is obtained.

The Oxide of Chrome gives a green colour; to it is due the beauty of the Emerald. Green Diallage, certain Serpentines, &c., also owe their colour to the *Oxide of Chrome;* whereas the *Chromic Acid* produces the beautiful red of the Spinel Ruby, the Chromate of lead, &c.

A magnificent yellow pigment, of every shade, from a deep orange to a pale canary-yellow, is prepared from the Chromate of Potash; and from the same substance, otherwise treated, an artificial oxide is obtained, which is now very extensively used in porcelain and enamel-painting. Leibig and Wöhler,

it is asserted, have lately produced a beautiful vermilion colour with Chrome. A blue Oxide of Chrome has also been obtained. It is believed that preparations of Chrome will soon become an object of interest to the calico-printer.

Metallic Chrome is obtained with difficulty, owing to the very great heat required for the reduction of its oxide. It is white, and magnetic in a slight degree, receives a good polish, and is unaffected by exposure to the air. Its specific gravity is said to be from 5·0 to 6·5.

And now, dear Florence, I have concluded all I had to say to you on the more important metals, and shall in my next endeavour to give you some slight notion of volcanic productions.

LETTER XXXI.

Volcanoes—Basalt—Compact Lavas—Porous Lavas—Lavas containing extraneous Minerals—Scoria—Volcanic Sand—Volcanic Ashes—Puozzolana—Obsidian—Marakanite—Pumice—Sulphur—Sal Ammoniac—Uses of Volcanic Productions.

IN the present letter, my dear Florence, I purpose speaking of some Volcanic productions. I shall, however, premise the subject with a word on Volcanoes themselves; for although these belong to Geology, it is desirable you should have some little notion of them, in order the better to understand the terms I shall have occasion to use in treating of Volcanic Minerals; and besides, I am anxious to forestall any questions you may feel disposed to ask me on the *cause* of Volcanoes, by shewing you at once how little it is known.

When from the general contemplation of the universe, we turn to a closer observation of our own planet, we are struck at every step with phenomena, all calculated alike to excite our wonder, our admiration, and our gratitude. If we are, at first sight, more forcibly impressed by some than by others, it is because some address themselves to us directly through the medium of our senses, while others require an intellectual effort, and are only discovered by experiment and induction; when once perceived they are all equally manifestations of the inconceivable power and consummate wisdom of the Creator.—Again, whatever is at once seen by man to be every way beyond his control, inspires him with awe; and

hence those phenomena whose scale of action exhibits a development of force against which he feels himself powerless, make a greater and more durable impression upon his mind, than those whose energies he knows he can limit or increase. Man, in reality, can no more control the laws by which the humblest plant vegetates than he can arrest the winds in their fury; but he can retard or accelerate the development of the plant, and even annihilate its vitality; while on the winds he has no power. Hence it is that, in all time, the mind of man has been forcibly struck with what are called the Grand Phenomena of Nature. The ocean in a storm, or the overwhelming waters of an inundation, the hurricane in its devastating course, the thunder of heaven, the quaking of the earth, and the burning mountain, inspire him with just dread, and rivet him in amazement of that power which alone can still the waves, calm the winds, and quench the volcano's fire.

But although man has no power over the great manifestations of nature's energies, his inquiring mind seeks unceasingly to comprehend the laws by which her actions are regulated; nor can he rest satisfied till he fancies he has discovered the causes of all the effects he sees. Prompted by this curiosity, he has succeeded in many cases and turned his discoveries to good account; and even when the knowledge he has acquired cannot be applied by him, it has still had its use, by unfolding to him fresh causes for admiration of the great First Cause. Nevertheless, there yet remains many subjects on which his ignorance is complete, and seems likely to remain so: and in the number of these must be classed Volcanic

Phenomena. All that is known of these beyond what we see and feel, is, that their immediate cause, whatever it be, is in the interior of our globe; but at what depth beneath the surface we are unable to say; nor do we know whether all the phenomena proceed from one and the same focus of action, or whether the many earthquakes that have been felt, and the numerous volcanoes which have been and are still in eruption, be due to different and independent sources of commotion.

To detail to you all the various hypotheses more or less ingenious which have been imagined to account for earthquakes, would be foreign to my purpose, and unsatisfactory as conveying no positive knowledge; but if philosophers differ as to the primary cause, they are all pretty much agreed to regard earthquakes as the effect of the endeavour of certain gases or vapours, engendered in the bowels of the earth, to escape from their confinement, and regard active volcanoes as the safety-valves, so to say, by which earthquakes are in a great measure prevented. Volcanoes have certainly, on different occasions, caused devastation; but seldom have their effects been comparable to those of earthquakes; and hence we have a fresh proof that what the inconsiderate regard as an evil and a disorder in nature, is, in fact, a providential arrangement designed for the greater security and well-being of ungrateful man.

Volcanoes then, are the orifices in the earth's crust by which the elastic vapours, engendered in the interior, escape in a comparatively harmless manner. These vapours are evidently the result of internal heat; but where or from what cause this

heat and these vapours originate, it is impossible to say with certainty. There are very plausible reasons for believing, if not in a central fire, at least that the earth at a certain distance below the surface is in a permanent state of incandescence, and accordingly, without asserting this to be the fact, we may admit it as affording a convenient and not altogether unsatisfactory manner of accounting for the sensible phenomena of volcanic eruptions.

By volcanic eruptions, is understood the more or less violent escape at the earth's surface of volcanic matter, whether gaseous, liquid, or solid, forced up from the depths beneath. Some eruptions take place without forming what is understood by a volcano; the earth after opening and effecting the discharge, again closing to be no more re-opened; and if such are included among, and are called volcanic eruptions, it is because the substances discharged by them are similar to those ejected by volcanoes, and have probably the same origin.

A volcano is a more or less perfectly conical hill or mountain, formed by the successive accumulations of ejected matter, and having one or more channels of communication with the interior of the earth, by which the ejections are effected.

Volcanoes are either active, intermittent, or extinct; and of those that are active, some emit lava and incandescent bodies, while others give out only vapour and gases. The intermittent are those which are occasionally quiescent and occasionally exhibit paroxysms of violent eruption; while extinct volcanoes are those whose communications with the interior have long since been closed, and which have

not been active in the memory of man. We have, however, no assurance that what are now deemed extinct volcanoes may not again burst out. Vesuvius, till the 79th year of the Christian era, was regarded as an extinct volcano.

The number of existing active and intermittent Volcanoes amounts to more than 300, while that of extinct Volcanoes is incomparably greater. In the Galapago Islands alone, says Mr. Darwin, there must be at least 2000 craters; but it is not known how many of them are active at present. Volcanoes exist in all parts of the world, and in different situations; generally, however, in the proximity of the sea, whose waters are supposed by many to be connected in some way with volcanic action. Several islands, as we have just said, are volcanic, and, in our own time, submarine Volcanoes have burst forth and raised their heads above the surface of the waters.

The substances ejected by Volcanoes are very different; they may be divided into five kinds, gases, vapour, water, mud, and solid matter. It is of the latter only that I intend to speak. Of the solid substances, some are produced, and some only modified, by volcanic action; while others, again, are unaltered substances, thrown out by the ejective force, and exhibiting little or no marks of the effects of volcanic heat. The two chief species of volcanic substances are lava and scoria, of both of which there are several varieties.

Basalt.—This is the most homogeneous, the most perfectly melted, and the most compact of the lavas; it is ejected in a state of fusion from the craters of Volcanoes, or from lateral openings, and runs

down the slopes of the mountains and along the plains at their base, with greater or less velocity according to circumstances. Sometimes the current is extremely slow; thus a stream of lava which burst out at the base of Mount Ætna, in 1614, continued in motion for ten years, and in that time had not advanced more than two miles. In other cases it is very rapid. In 1794, the lava of Mount Vesuvius took only six hours to run four miles; and in 1804, it is said to have moved with the rapidity of the wind; and in four minutes it had gone three quarters of a mile, though the slope over which it ran was of very gentle descent.

The lava not only runs with greater or less velocity, but cools more or less rapidly: a very few months are sometimes sufficient to cool it, while in other cases it is not cooled after years. Thus, in 1788, Spallanzani found on Mount Ætna a stream of lava that had ceased running for eleven months, but was still smoking and red hot in its interior; and lava of Vesuvius has been found to be hot five years after its ejection. Mr. Lyell says it is not uncommon for lava streams to require more than ten years to cool in the open air, and when they are of great depth, a much longer period. The melted matter poured out from Jurillo in Mexico, in the year 1759, which accumulated to the height of 550 feet, was found to retain a high temperature half a century after the eruption. The exterior of the lava generally cools and solidifies in a very short time, and as in this state it is a bad conductor of heat, it tends to maintain so much the longer the interior heat and fluidity of the mass.

Basalt differs greatly in character, according to the inequality in the proportion of the ingredients of which it is composed, the difference in the degree of its original fluidity, the length of time it has required to cool, and the pressure to which it has been subjected while in its viscous state; which latter depends upon the thickness of the mass; a fact that explains why the character of the same mass varies at different depths.

The chief ingredients of Basalt are Felspar and Augite, the latter predominating; besides which, it occasionally contains other substances that diversify its appearance. Augite, or Pyroxene, differs from hornblende only in the form of its crystals, those of Augite being the result of a quicker cooling. The constituents of Basalt are not only in greater or less abundance relatively to each other, but occur in different states and variously modified.

The usual colours of Basalt are various shades of black and green; but sometimes bluish. It takes a fine polish; always contains iron, and not unfrequently in such quantity as to attract the magnet. It is fusible alone. The name is derived from *Basil*, which in the Hebrew, Syriac, Chaldean, and Arabic languages, signifies *baked*, or *burnt*.

Basaltic masses occur of immense extent in some countries, nor are they confined to those where there are active, or even extinct, volcanoes in the vicinity: that they are the result of ancient eruptions there can be no doubt; but time and the elements have obliterated the traces which might lead to the discovery of the sources of these old lava streams.

To the generality of persons, the name Basalt

always conveys the idea of columnar rocks; but although Basalt does, in a great many cases, assume the columnar form, this is by no means essential to it, for it occurs also tabular, and spherical, and in irregular masses. The columns, or, more properly speaking, prisms, vary considerably in size and in the number of their sides, which ranges from three to nine; the triangular, square, and nine-sided prisms are, however, rare. The columns are sometimes entire and sometimes articulated, and, in the latter case, the face of one joint is convex, while the corresponding face of the next is concave to receive it. In our own country we have some admirable specimens of basaltic columns, as at Antrim, in Ireland, and Staffa, in Scotland; and although these have been repeatedly represented and accurately described, those who can go and see them should certainly do so, rather than remain satisfied with reading about them.

Basalt is generally very unalterable, notwithstanding which, some of the columnar kinds are found to be externally modified in colour and consistence; the exterior becoming softer and brown from the oxydizement of the iron contained in the mass. The altered part does not, however, form a distinct crust, but shades off gradually into the colour and character of the unaltered interior. The thickness to which the alteration penetrates, is different in different cases; sometimes it does not exceed the tenth of an inch, sometimes it goes so deep as to leave only a small unaltered portion in the centre, and sometimes the whole mass is changed. What appears extraordinary is, that the hardest, the most

compact and homogeneous kind of Basalt, is sometimes found to be more changed externally than columns of a less compact and homogeneous texture, though of the same date. To attempt an explanation of this seeming anomaly would lead me too far.

Every volcano does not furnish Basalt, but they almost all eject lava of some kind or other; and it is remarked that the lavas of American volcanoes differ from those of Europe, the felspar of the latter being replaced by albite in the former. Moreover, the same volcanoes produce different lavas at different times.

Besides that particular pyroxenic, or augitic and compact lava I have spoken of under the name of Basalt, there are many other kinds, differing greatly in colour, in compactness, and hardness: some are exceedingly light and porous. Of the more compact varieties, many are very beautiful from the colour and arrangement of the substances of which they are composed. Thus some exhibit crystals of white or whitish felspar, in greater or less abundance and of various sizes, on a dark-coloured ground, while in others the crystals are red on a light-grey ground. These lavas, when cut and polished, vie with the most esteemed porphyries, and are called *porphyritic lavas*; they abound on Mount Etna. Some lavas, again, of a greyish colour, are relieved by crystals of black or green pyroxene, (the same substance which in the more homogeneous basalts is in a very comminuted state and equably distributed throughout the mass). Others contain olivine, or peridot, or *Chrysolite of the Volcanoes*, in grains and crystals of various sizes, from that of a small pin's head to

an inch and more in diameter. These olivines are of different shades of yellow and green, and when the paste of the lava is black, produce a very pretty effect. Large masses of amorphous olivine, sometimes weighing from 60 to 80 lbs., are found in the basalts of the Rhine near Cologne. *Spinelle Pleonaste,* in small octahedral crystals, occasionally occurs in some of the Vesuvian and Etna lavas. Besides these varieties of lava, there are others which contain olivine and crystals of felspar and of augite in the same specimen.

The lighter and cellular, or porous lavas, are perhaps more useful in their applications than those that are compact, from which they differ only, as Dolomieu has well expressed it, "in the same way that leavened does from unleavened bread." All the compact lavas have their associated and dependent porous lavas, the solid parts of which have exactly the same characters, properties, and ingredients, as the compact ones.

All the lavas, whether compact or porous, occur occasionally, like the basalts, in columns, and tabular. I have no doubt you would like to know how lavas acquire the prismatic and tabular and spherical forms, as also why some lavas are porous and others compact; but were I to attempt to satisfy your curiosity on these matters, my letter would be swelled into a treatise. I trust, therefore, you will excuse my not entering into such details. Remember, my object is not to treat of volcanoes and their phenomena, but to give you a notion of some of the more interesting and valuable volcanic productions. To return then to our cellular lavas. Their cavities

are in some cases empty, and in some filled up completely, or in part, with substances which are not of contemporaneous formation with the lava, but are subsequently introduced; these substances are principally *calcareous spar* and *zeolite*. When the mass of the lava is dark in colour, and the pores regular and equidistant, the white spar or zeolite with which they are filled up produces a very agreeable appearance. The calc-spar is usually radiated from the centre to the circumference of the little balls. If the cavities are very large, they are not always filled, but lined with druzy crystals. Occasionally very beautiful tufts of long and diverging prismatic or pyramidal crystals are observed. The zeolites occur in like manner, filling wholly or in part the cavities of the lava. This substance is either in radiated and silky masses, or crystallized in cubes and forms derived from this (*Analcime*). In some cases the zeolite is very abundant and hard, so that the whole mass is susceptible of receiving a very fine polish. The zeolitic lavas are very abundant in the Cyclopean islands, (Fariglioni near Catania, on the East coast of Sicily). Other substances are found in lava, such as *Leucite*, or *White Garnet*, *Calcedony*, and *Agates*, &c. Some of the older lavas near Frascati, and other places in Italy, contain the white Garnet in immense quantity. Calcedony is particularly abundant in volcanic formations, as in the Feroe Islands and Iceland; in Auvergne, in France; and, according to Andreossi, at the North-eastern extremity of the Bosphorus, on the European side.

Scoriæ, another production of volcanic eruptions, has been divided into two kinds, the heavy and the

light; the first being formed on the surface of the lava currents, and the second ejected from the craters. All the Scoriæ are more or less vitrified masses, and are more or less cellular. The solid parts of the more compact still retain some of the characters of the lava to which they belong; but in the lighter ones, the divisions between the cells are so thin, that their character is quite altered and undistinguishable; they are, however, frequently found to contain the crystallized substances which enter into the lavas. Indeed, the detached crystals of augite, felspar, and peridot or olivine, that are found in the neighbourhood of volcanoes, have fallen out of the Scoriæ.

Volcanic Scoriæ, especially those of the lava-streams, have a close resemblance to the Scoriæ of our furnaces; and while the lavas of different Volcanoes, as I have said, differ, the lighter Scoriæ of them all are similar. Sometimes a mass of solid lava or other stone is found imbedded in the Scoriæ, and sometimes a lump of Scoriæ is enveloped by compact lava. The external forms of the masses of Scoriæ are very various, and occasionally very curious; their size varies from that of a nut to immense blocks and tables. The more porous kinds, when large, are so light as to float upon water, and hence they have sometimes been carried out to sea by winds and currents, and cast on shore at distant places, where they have been taken for petrified sponge.

The Scoriæ ejected from the orifice of a crater differs from that formed on the surface of lava-streams, in being generally in very small pieces, very light, and, so to say, more burnt; they are of various colours, and go by the names of *Rapillo Nero* and

Rapillo Bianco. It is the accumulation of these by successive eruptions, that forms the conical summits of volcanoes, and conical mounds and hills which surround their bases. The great lightness and want of cohesion of these Scoriæ cause them to be rapidly removed by wind and water, and hence the comparatively small quantity of them found in or near extinct Volcanoes.

Volcanic Sand is nothing more than comminuted scoriæ, which may be traced, diminishing in the size of its grains, from the bases of the volcanoes to a considerable distance. It is sometimes grey or red, but more generally dark-coloured, or even black; particularly in the bottoms of ravines and water-courses, where the lighter particles have been washed from it, and where it is found intermixed with augite, peridot, &c., in perfect or fractured crystals. In some places the Volcanic Sand is found accumulated to a height of twenty feet. This Sand should not be confounded with Volcanic *ashes* and dust, as is generally done by most persons.

Volcanic Ashes, or Dust, differs essentially from the sand just mentioned. It consists of very fine particles, a great portion of which is argillaceous, the rest being calcareous earth, magnesia, and iron, with a little quartz, and sometimes a trace of sal-ammoniac. It forms with water a pasty ductile mass, that may be employed in pottery: its colour is usually reddish-grey. The natural mixture of this substance with volcanic sand, scoriæ, and puozzolana, binds the whole together, and forms *Volcanic Tufa.* It is a mass of this kind that covers Herculaneum and Pompeii to a height of seventy feet! Its fertility

is remarkable, and accordingly it in a great measure compensates for the devastation caused by the lava-streams and the sterility of the volcanic sand. It is nevertheless extremely annoying to those who live in the vicinity of active volcanoes; for its fineness is so great that it is carried by the air into the houses, entering the minutest fissures, penetrating drawers, cupboards, and even getting mixed with food. The distance to which it is carried by the winds is sometimes exceedingly great; that from Vesuvius, according to Sir William Hamilton, having fallen at places two hundred miles distant from the volcano. Ships a long way out at sea have been greatly surprised by falls of dust, for which, at the time, they could not account, but which were afterwards ascertained to be the result of distant volcanic eruptions.

PUOZZOLANA.—This substance, one of the most valuable furnished by volcanoes, owes its name to the town of Puozzoli, near Naples, whence it was originally procured. Formerly it was called "*Powder of Dicarchia,*" such having been, in ancient times, according to Pliny, the name of Puozzoli. Puozzolana occurs of various colours, brown, yellow, reddish, and grey, the two former very abundant in Italy; the reddish and brown are considered the best. Faujas de St. Fond informs us, that the catacombs of Rome are all excavated in a kind of violet-brown Puozzolana, enclosing small crystals of augite, (he calls it *Shorl,* the name by which augite or pyroxene is called in all the older works on volcanic productions). But Italy is not the only country in which this important substance is found. It exists in

greater or less abundance near the mouths and craters of volcanoes in all countries, though not always equally easy to be got at.

I must not enter into any explanation of the mode of formation of Puozzolana; suffice it to say, that it has been found by analysis to be of exactly the same nature as the most compact basalt, the cellular lavas, and the scoriæ: it is therefore an altered lava. The causes of the conversion are various, and the forms under which Puozzolana is found to exist are also different.

Obsidian, or Volcanic Glass.—There has been much disputing among philósophers respecting this curious substance; some maintaining it to be an aqueous production, and others asserting it to be a result of igneous fusion. It is certain, however, that it is only found *in situ* among rocks whose volcanic origin cannot be doubted; which, together with the well-known easy fusion of lava into a vitreous mass, and other circumstances, incline me to regard it as volcanic.

Obsidian presents various colours and appearances, being black, grey, green, avanturined, &c.; sometimes it is quite opaque, sometimes translucid, and occasionally transparent; its fracture is conchoidal and its edges very sharp. It occurs in extensive beds, large masses, and smaller isolated pieces. In Europe, it is particularly abundant in the Island of Lipari, where, according to Spallanzani, the hill upon which the town and castle of the same name stand, is one huge mass of Volcanic Glass. Obsidian in mass and streams occurs abundantly in the Æolian Islands, off the northern coast of Sicily,

at Teneriffe, and in the Peruvian and Mexican Andes. I possess some very pretty specimens of bottle-green avanturined Obsidian from the latter locality. Obsidian in parallel beds or strata is seen in Iceland, in the Andes, and in the Lipari Islands. Near Campo-Bianco there is a mountain entirely formed of beds of Volcanic Glass. In this locality it is full of cells, some of which are empty, and others crossed by fine transparent filaments of glass in a reticulated arrangement.

Some Obsidians envelop other substances, as semi-vitrified crystals of felspar, or Obsidian of a different kind, or are varied by opaque spots and lines, &c. Near Okotsk, in Kamstchatka, rolled pieces of transparent Obsidian, about the size of a nut, are found; they are of a smoky-grey colour, and are exceedingly pretty objects: they are known by the name of *Marekanite.* Mixed with these are larger pieces of a volcanic enamel quite opaque, of a black colour with red veins.

PUMICE is a production known to most persons, there being few houses in which it is not occasionally used for some purpose or other: nevertheless, I will describe it generally It occurs in porous masses that are very light, the pores are round, or more or less elongated; when long they are narrow in proportion, and the mass acquires a somewhat fibrous texture. It is easily broken, feels very harsh, and will scratch glass and steel. The more solid parts have a vitreous aspect, and when delicately fibrous, a silky lustre. As it is a vitrification, it is susceptible, like artificial glass, of receiving various colours according as different metallic oxides enter into its composition; and

consequently, although the usual colours of Pumice are pearl-grey and yellowish-white, it is occasionally bluish, reddish-brown, and even red, as at Vesuvius —brown and green at Teneriffe, &c. It melts easily before the blow-pipe into a white enamel.

Pumice is found in the neighbourhood of certain Volcanoes and in volcanic regions, where it occurs in disseminated lumps, enclosed in beds of the pulverulent volcanic productions, or in distinct beds; still however in separate pieces of various sizes, from that of a nut to that of a large melon. In some cases there are pumaceous masses which appear to have flowed and cooled upon the spot; the cells, in this case, are drawn out in the direction of the current. The substances mentioned as occurring in lava and scoriæ are also occasionally found in Pumice.

That Pumice is a volcanic production there seems little doubt, though some philosophers maintain that its origin is aqueous. Be this as it may, it is justly regarded as a modification of Obsidian; for when this latter is heated, it is converted into Pumice, and in many cases the blackest Obsidian passes insensibly into the most perfectly characterised Pumice. Now as we have seen that solid lava passes into Obsidian, it appears obvious that Pumice is only a further modification of lava. It is probable that Obsidian is lava or basalt fused under pressure, while Pumice is the result of a similar violent fusion without pressure. Mineralogists are much divided as to the nature of the rocks which, by volcanic fire, have been converted into Pumice.

Pumice is not found in all volcanic formations: thus there is none on Etna, nor in the Vivarais, and

very little in the environs of Vesuvius; but it is particularly abundant in the Islands of Lipari and Vulcano. Campo-Bianco, about thirty miles from the Port of Lipari, furnishes almost all the Pumice of commerce. It is, however, found in many other places. At Andernach on the Rhine, it occurs in small pieces, from the size of a nut to that of a pea: these last, near Engers, are enveloped in a kind of muddy cement, not very solid, which is cut into the form of large bricks and used in building.

Sulphur I have already mentioned in speaking of combustible minerals, Letter xxi., and I there stated that it is found in great quantity in volcanic regions. That which occurs in volcanic craters and solfataras is the produce of sublimation, and is in fact flowers of Sulphur; its colour varies according as it is mixed or not with arsenic. In some cases, the sublimed sulphur is subsequently melted by heat so as to form stalactitical masses, and in others it is crystallized. Perhaps some portion of the Sulphur of craters may be derived from the decomposition of sulphuretted hydrogen gas.

Sal Ammoniac is another volcanic production. Both it and sulphur, and some other substances, are not the result of violent eruptions, but are formed during the more quiescent state of active volcanoes.

I have said, that of the solid substances ejected by volcanoes, some are produced, and some only modified, by volcanic action; while some exhibit hardly any marks of the effects of heat. It is impossible for us to say whether or not the melted masses which flow out in streams of lava during the eruption of a volcano are derived from rocks

such as we find at the earth's surface, or if there be not, at those depths where the focus of volcanic action is situated, some rocks or mineral substances quite different from what we see at the surface. In the former case, the most compact lavas themselves will be only substances modified by volcanic fire. But I do not mean to go so deeply into the subject. I will merely observe, that by solid matter formed by volcanic action, I allude to those substances which we see to result from volcanic fusion, such as the basalts, lavas, scoriæ and sand, and which differ from those that appear to have had some other origin. The modified substances are the altered felspars, the puozzalanas, and ashes, which two last would appear to be modifications of clay, the calcined lime-stones, &c.; and by unaltered substances, I mean such pieces of granite &c., as are occasionally ejected with very little appearance of alteration.

There are many rocks which are supposed to be of igneous origin, such as Porphyries, Trachites, Trap, &c.; but these rocks are compound substances, not simple minerals, and from their bulk, &c., belong to Geology, which we have at present nothing to do with. Having therefore now completed the enumeration of the principal solid volcanic productions of which I was desirous of giving you some little idea, I will conclude by a word on the uses to which they are severally applied.

Basalt takes a very beautiful polish, and has the intensity of its colour thereby greatly increased; it is, moreover, almost indestructible. These qualities render it well calculated for the purposes of sculp-

ture, and accordingly statues, pillars, and other objects, have been made of it. Specimens of Egyptian statues, sarcophagi, columns, &c., of black and green basalt, may be seen in the British Museum. It must, however, be observed that this stone is exceedingly hard and tough to work, and requires much labour and the most excellent emery to bring it up to its full polish. This is the reason why it has been so seldom employed. Egypt is not the only country that has worked basalt in this manner. Messrs. Lechenault and Humboldt have brought to Europe, the former from Borneo, and the latter from America, statues of this substance, but of a more porous character than the close-grained compact basalt. Some of the statues brought from Egypt are supposed to be of trap-rock, but this is only another name for a very ancient basalt, or at least a very analogous rock, equally the result of igneous action. Some of these Egyptian sculptures, when mutilated, have been repaired by Roman artists with Italian basalt so similar in appearance as almost to defy detection of the restorations.

Basalt and solid lavas in general form most excellent paving-stones, and have accordingly been employed as such in several places. Rome, Naples, Venice, Padua, Coblentz, Agde, and many towns in Auvergne, are paved with basalt and lava. The prismatic basalt is the best for this object, and Montelimar, in the department of the Drome, is paved with a black prismatic basalt obtained from the quarries of Chenavari, on the right bank of the Rhone. According to the experiments of Rondelet, basalt is, of all stones, that which bears the greatest

weight without being crushed. The black colour, however, of some of the lavas, as that of the *Pietra Dura*, with which Naples is paved, is objectionable on account of the intense heat it acquires, which renders walking upon it sometimes intolerable.

Another purpose to which basalt has in some places been applied, is for building; but, in this case, the rough stone is used, as the cutting of it into regular blocks would be attended with immense expense. It is, however, admirably suited for inscriptions, as the characters may be cut with extraordinay sharpness, and the angles remain perfect for any length of time.

In some parts of Germany, basaltic prisms are used as street-posts, and placed in a row as garden-fences; also for ornamental work in picturesque gardening, as at Wissenstein, &c.

The basalt of Unkel and that of Stolpen is used by the German goldbeaters as anvils for their work, and by the Dutch it is converted into a substitute for puozzolana. There is a particular close-grained kind, of which excellent touchstones are made for trying gold. As basalt easily melts into a black glass, bottles are made of it in some places.

Some compact lavas, as I have said, are very beautiful: thus, a grey kind with black spots, which is not very hard but takes a good polish, is worked at Vesuvius, into slabs and vases, some fine specimens of which may be seen in the Gallery of living painters in the Luxembourg, at Paris. There is also a Vesuvian lava of an ash-grey or slate-black, with round white spots (which are *Leucites*), of which pretty objects are made. M. de Dree's Cabinet con-

tained two vases made of this substance. At the town of Puy, in France, a lava is worked, which is of a greenish-grey with black spots; it takes a very beautiful polish, and pillars have been made of it for the decoration of the Cathedral. There are many other very pretty lavas, which are worked as pedestals, paper-weights, slabs, boxes, &c. and are well known to those who have visited Naples.

The porous lavas being much more easily cut and fashioned, and lighter than the compact, are better suited for building purposes than the latter, and they are accordingly often used in construction. The corner-stones, window-dressings, and door-lintels of the houses of Mascali and Giarre, and of Catania in Sicily, are made of porous lava, and plates of the same substance have been used for roofing. Cellular lava also makes very good mill-stones, and is extensively used for such at Malta, Sicily, and Calabria.

With regard to the Scoriæ I have little to say, further than that they are used like porous lava, in building, particularly for arches. Some of the specimens are very curious in external form, and are preserved in cabinets on that account. At Etna, the masses of Scoriæ sometimes form natural caverns; these are improved by art when necessary, and used as ice-houses for the preservation of snow.

Volcanic Sand, so far from being a valuable production, is a cause of sterility, and has no application, unless the very trifling one of being used when washed, and fine in colour and grain, as sand for drying writing.

Of the Ashes and Dust I have nothing to say beyond what has already been mentioned.

Puozzolana is perhaps the most important of all the volcanic productions; its chief use is in the preparation of cement of superior quality, particularly for constructions under water, as for piers, quays, embankments, foundations of bridges, aqueducts, and reservoirs, as also for the arches of cellars, the facing of walls to preserve them from damp, &c.

The value of Puozzalana was very anciently known, at least 2000 years ago; and the Romans, who excelled in the art of building, considered it as essential to the solidity of their constructions. Vitruvius calls it 'an admirable production.'

Puozzolana forms hills of considerable extent to the S.W. of the Apennines, in the district of Rome, the Pontine Marshes, Viterbo, Bolsena, and, as before mentioned, in the Neapolitan region of Puozzole, and various parts of the world.

The Roman Puozzolana was shipped at Civita Vecchia for Sweden, France, and Holland. France, however, now takes much less than formerly, if, indeed, she imports any, since the discovery of large deposits of it in her own ancient volcanic districts; and Holland, as I have already observed, prepares an artificial Puozzolana from Basalt.

The cause of the esteem in which Puozzolana is held for *hydraulic mortars*, is the property which it communicates of quickly setting under water and becoming exceedingly hard and durable. It is mixed with lime and sand in various proportions, according to the quality and nature of the lime and the particular purposes for which the mortar is required. The Puozzolana itself is of various qualities of fineness and colour.

Faujas de St. Fond has given a very detailed memoir on Puozzolana, and the cements prepared with it, in his *Recherches sur les Volcans Eteints du Vivarais et du Velay ;* but this is for civil engineers, not for my pretty Cousin, who, knowing perfectly well how to cement lasting friendships, need not trouble her head about any other kind of cementing, unless, becoming an old maid, she may like to amuse herself with mending her broken china.—But to return.

In Hessia and other parts of Germany, there is a volcanic production, a kind of tufa, called *Tarras*, which being properly prepared, forms as good a Puozzolana as that prepared in Holland. A similar tufa is found in large quantity in the North of Ireland and elsewhere. In England, however, our hydraulic cement is now prepared from what is called *Cement Stone*, found in the river-cliffs of the islands of Sheppey and Thanet, in the Thames, and along the coasts of Yorkshire, Somersetshire, and the Isle of Wight, &c.

Obsidian.—With regard to this substance and the uses to which it is applied, I cannot do better than translate for you, textually, what M. Brard says of it.

" *Black Obsidian,* which appears opaque in the mass, is really grey and translucent on the edges and in thin fragments. It occurs in Iceland, round Mount Hecla, at the Islands of Lipari, Madagascar, and Ascension ; also near Quito in Peru, in Mexico, and at Tokay in Hungary. The fine polish which it takes has caused it to be much sought after for mirrors. In the time of Pliny it was brought from Ethiopia. The ancients esteemed it greatly, and

Augustus presented to the Temple of Concord four Elephants made of it as wonderful objects. The Guanches of Teneriffe, the natives of Peru, and many other people of the New World, made mirrors of it, and shaped it into arrow-heads, knives, and poignards. The Mexican volcano which furnished this Obsidian is still called the 'Mountain of Knives' (*Serro de las Nabayas*). Hernandez asserts that he has seen a hundred knives made in an hour.

"In Europe, and particularly in the north, mourning ornaments are made of Obsidian, improperly called *Iceland Agate ;* but the most interesting of its uses is for the black mirrors employed by landscape-painters. Very fine ones may be seen in the Museum of Natural History at Paris, which are made of the Obsidian of Peru. A mirror of this kind was sold by auction for 140 francs. *Green Obsidian* has the same properties as the black. Don Ulloa pretends that the hatchet of the Incas was made exclusively of this variety, which is abundant in Peru, but was probably more esteemed than the black.

"*Chatoyant*, or *Avanturine Obsidian*, when cut and polished *en cabochon*, has a very pretty effect, having chatoyant specks of yellow and russet upon a green or black ground. M. Pujoulx states that a fragment of this kind, of the size of the fist, being cut into pieces and polished, fetched more than 20,000 francs, by the sale of it in detail in the north of Europe.

"The Paris jewellers sometimes keep trifles made of Obsidian, but these have little chance by the side of the brilliant gems that are in the cases with them.

"The Abbé Grosier says that the Chinese made their first mirrors of a black *iu* stone, which appears to be black Obsidian."

To this I may add, that it is asserted by some, that the knife used by the Jewish priests in former times, for certain religious purposes, was made of Obsidian.

Pumice is a very valuable object in many arts. Its principal use is for polishing wood, ivory, metals, glass, and some of the softer stones, slates, marble, lithographic stones, &c.—It is also used in the preparation of skins, vellum, and parchment. It is useful for some domestic purposes, and in Europe, as in the East, is employed in the baths for rubbing down corns and similar callosities. The quantity required for the arts is exceedingly great. I know not how much is annually used in England; but France, in the years 1816 and 1817, imported upwards of 264,000,000 lbs., of which 72,000,000 lbs. only were re-exported. Now as it is very light, the quantity in bulk must have been great. In the English market, Pumice is sold for £8 or £10 the ton.

Of *Sulphur* and its uses I have already spoken in a former letter, as also of *Sal-ammoniac.*

Vesuvian, or *Idocrase*, is a very inferior gem, sometimes of an agreeable yellow-green colour, found at Vesuvius and in other places; it is cut and sold at Naples.

And now, my dear Florence, I have brought this very long letter to a conclusion at last. I think it contains all that you need know on volcanic productions; would you learn more, you must have recourse to works treating specially on the subject.

LETTER XXXII.

Coral—Pearls—Amber—Turquoise.

BEFORE I conclude this series of letters, my dear Florence, I have yet to speak to you of a few objects which, though not strictly belonging to the class of minerals, you will often see arranged along with them in the cabinets of the curious; and as they are used in jewellery and for other ornamental purposes, I presume you will not be sorry to know something about them. The substances to which I allude are Coral, Pearls, Amber, and Turquoise.

CORAL is the stony habitation of a species of polypus, to which it bears the same relation that the shell does to the snail, its architect, proprietor, and inhabitant. Coral, in fact, is a marine *zoophite*, this latter term meaning, etymologically, an *animal plant.*

There are many varieties of Coral, but I mean to speak only of that which is used for ornamental purposes; it is called *Gorgona Nobilis*, and varies in colour, being black, white, yellow, and red. It is found adhering to rocks in the form of a leafless plant; having, however, nothing of the plant but its appearance: it is attached to the rock by a broad base, and grows (if we must so say for want of a better term) downwards. In length, it rarely exceeds one foot; it is branchy, and the principal stem, which is slightly ribbed, seldom is more than an inch in diameter. The whole is studded with cells, each of which, contains an insect; and when these little

polypi extend their feelers, the whole looks like a curious plant in flower. All the kinds I have mentioned are used for ornamental purposes; the black is the most esteemed, but it is scarce; the white and yellow are also worked; but it is the fine rich scarlet Coral which is best known and most abundantly employed. As a greater rarity, the pale pink is by some preferred.

The depth at which Coral is found in the sea differs greatly, ranging from a few fathoms to upwards of a hundred. Its principal known locality is the Mediterranean, particularly round the Lipari Islands, in the Strait of Messina, and on the Coast of Barbary. The French and Sicilians are the only people who make Coral-fishing a regular branch of industry. The former, on the coast of Barbary, reap an annual profit for their labour of 360,000 francs. The Sicilians, who fish round Lipari, Vulcano, and in the Strait of Messina, obtain about 3000 lbs. weight of Coral per annum. What the value of this may be, it is hard to say, for the price varies very much according to the quality; thus the best Sicilian Coral, *viz.* that which is large and solid, with depth and brilliancy of colour, fetches from eight to ten guineas an ounce, while the inferior kind can hardly be sold for one shilling a pound.

Besides the places mentioned, a small quantity is obtained at Minorca and Majorca, and on the coast of Provence. It also exists in other seas besides the Mediterranean.

As Coral requires eight or ten years to come to perfection, the spots where it is fished are divided each into ten portions, and one only of these is fished

in the year, so that each may remain at rest the time necessary for bringing it to maturity. The mode of fishing or rather dragging for Coral is as follows:—Two stout pieces of wood are tied together cross-wise; to the centre a weight is attached, and at the ends of the arms pieces of net are hung; the arms themselves being also loosely twisted with net and tow. This is let down by a strong rope from the boats, and an expert diver sometimes goes down to push the arms under the rocks where the Coral hangs; the boats are then rowed along in the proper direction; the wooden arms break off the branching Coral, which, in falling, gets entangled in the nets and tow, and is drawn up.

Coral is composed chiefly of carbonate of lime with portions of gelatine and animal albumen; when fresh, it is surrounded with a pellicle of animal matter: it has a fine grain, and being hard, takes a good polish, which, together with its fine colour, renders it appropriate for the particular purposes to which it is applied.

Coral, as you well know, is used for ornamental objects; as bracelets, ear-drops necklaces, medallions, &c., and for that particular plaything given to children when cutting their teeth, and which is expressly called *a Coral.* This production was very anciently known, for Pliny says it was applied by the Gauls, and by the people inhabiting the maritime parts of Italy, as well as by other nations, for ornamenting their armour and household furniture. Caylus has published an antique head of Medusa in Coral, having the eyes made of a white substance like shell; it was probably worn as an amulet, from the

idea of some mystical analogy between the substance and its supposed origin.

Ovid tells us, that Perseus having deposited the bleeding head of Medusa or Gorgona on a tuft of growing plants by the sea-side, the plants imbibed the blood, and became red and petrified. The sea-nymphs marvelled much at the transformation, and amused themselves with breaking off fragments and casting them into the sea. Each piece so thrown became the seed of fresh Coral. I am sure the ladies must be much obliged to these fair Undines.

Formerly, many virtues were attributed to Coral; it was supposed to stop bleeding, to preserve houses from thunder, to keep off evil spirits, &c. It was said to be much finer in colour when worn by men than when worn by your sex; whether this was meant as a compliment or not, I am unable to say. At the present day some people believe that Coral necklaces become pale when the wearer is, or is about to become ill. There is no doubt but Coral loses its colour by time and exposure.

In the East this substance always was, and is still, highly prized. Marco Paolo, the celebrated Venetian traveller, says, that Coral was used as money in his time, and indeed as the only currency, by the people of Thibet; he also says the women wear it about their necks and ornament their idols with it. Tavernier, another celebrated traveller, in concluding his remarks on this substance, says, that throughout Asia all the common people adorn their persons with it, wearing it round their necks and arms; and that this is particularly the case towards the North, in the States of the Great Mogul and to-

wards Assam. It is certain that, in the present day, many of the arms, horse-caparisons, &c., of the Orientals are studded with Coral.

An artificial production is made in imitation of Coral; it is prepared with powdered marble and fish-glue, and coloured with vermilion and minium.

PEARLS, so well known as the most becoming ornament of modest beauty, are obtained from different kinds of shell-fish, but more particularly from the Pearl-oyster (*concha margaritifera*). This mollusc is fished, says McCulloch, in various parts of the world, particularly on the west coast of Ceylon; at Tuticoreen, in the province of Tinnevelly, on the coast of Coromandel; at the Bahrein Islands, in the Gulf of Persia; at the Sooloo Islands; on the coast of Algiers; off St. Margarita, or Pearl Islands, in the West Indies, and other places on the coast of Columbia; and in the Bay of Panama, in the South Sea. Pearls have been sometimes found on the Scotch coast, and in various other places.

The mode of fishing or diving for Pearls has been so repeatedly described in popular works, that it cannot be new to you. I will therefore merely say, that it is a very dangerous, pernicious, and, in the Persian Gulf, unprofitable occupation for the divers. It is dangerous on account of the sharks; and as the exertion is extremely violent, the divers are unhealthy and short-lived.

There exists great diversity of opinion as to the mode of formation of the Pearls, but the prevailing one seems to be, that they are the result of a disease, caused, it is supposed, by the introduction of some foreign body within the shell, and are formed

like bezoards. Should this be the fact, it would appear that the disease is endemic among these molluscæ, being peculiar to certain localities. Pearls are formed of concentric layers or coats of carbonate of lime, interstratified with animal membrane.

Pearls are occasionally met with in the common oyster, and in muscles; but besides sea-pearls, there are fresh-water Pearls. Thus the river Elster, in Saxony, from its origin down to Elsterberg, as well as the rivulets which fall into it, produce Pearls, and a fishery for the benefit of the sovereign was established there in 1621. Also in the river Watawa, in Bohemia, and in the Moldau river, from Kruman to Frauenberg, Pearls are found, sometimes of great beauty and difficult to be distinguished from oriental Pearls. Some of the streams in Finland also furnish Pearls. In all these cases it is a muscle that produces the Pearls; but though occasionally good, they are generally of a leaden hue, which greatly detracts from their beauty.

Pearls differ in size, colour, and form. With regard to the former, they vary from the size of a pigeon's egg to that of a small pin's head; Pearls of the usual size are called *Ounce-pearls*, and the smallest, *Seed-pearls*.

The general colour varies from white to yellowish; the former tint is the most esteemed in Europe, the latter most prized in the East. Pearls are occasionally found black and pink; these latter on the coast of Borneo and Ceylon. The Japanese call them *Shell-jewels;* the black is esteemed for its variety, and the pink for both rarity and beauty. Those Pearls that have a bluish or leaden-grey tint are not esteemed;

and, unfortunately, the finest Pearls, in time, acquire this bad colour. Pearls should be kept in dry hair-powder.

The form of Pearls is either spherical, orange-shaped, oval, pear-shaped, or irregular. Those Pearls that are at the same time very large, perfect in their form, whatever this may be, of fine colour, and reflecting and decomposing the light with much vivacity, are highly esteemed, and fetch enormous arbitrary prices. Pearls of ordinary size, sold without being sorted, usually fetch £80 the pound weight; when sorted, their value increases in the geometrical proportion to the size, perfect shape, and colour. The sizes are sorted by sifting. Ten sieves, with holes of different sizes, are placed one above the other; the Pearls are thrown promiscuously into the first sieve, that which has the largest holes; in it are retained all those that are of the size of a large pea; those of the second sieve are smaller and are called second class, and so on to the last, which is the *Seed-pearl.*

According to Mr. Milburn, a handsome necklace of Ceylon Pearls, of the second class, or smaller than a large pea, costs from £170 to £300, that is, about one guinea each Pearl; but one of Pearls about the size of peppercorns may be sold for £15, or 1*s.* 6*d.* each pearl. Independent of the real value of Pearls, their price is liable to vary by reason of the fashion; and now that this beautiful production is so admirably imitated, the price of Pearls is much lower than formerly.

The quantity brought into the market is, however, still considerable, as may be learnt from the

following statements. The Pearl-fishery in the Gulf of Manaar is generally sold by government to the highest bidder, who is usually a black merchant. In 1769, it was sold for £60,000; in 1797, for £110,000; in 1798, for £140,000. McCulloch says that at Bahrein alone, in the Persian Gulf, the Pearl-boats amount to 1500. The trade is in the hands of the merchants, the divers themselves getting a bare subsistence. Here the annual amount produced by the Pearl-fishery may be reckoned at from £200,000 to £240,000, which is only one-sixth part of what the native merchants assert it to be; it is, however, an enormous annual value for an article found in other parts of the world as well as here, and which is never used in its best and most valuable state except as an ornament. Large quantities of the Seed-pearl are used in the East for electuaries.

The fisheries of Columbia, says McCulloch, were at one time of great value. In 1587, upwards of 697 lbs. of Pearl are said to have been imported into Seville; but for many years past the Columbian fisheries have been of comparatively little importance.

Mention is made of some very remarkable Pearls which have been valued at most extraordinary prices. Thus from the Columbian fishery just mentioned, Philip II. received a Pearl which weighed 250 carats: it was of an oval form and of the size of a pigeon's egg, and was valued at £36,000. The Pearl which the celebrated Cleopatra is said to have dissolved and to have drank off in a cup of wine to Antony, was valued at upwards of £5000:—other authors say much more. I find among my notes the following account, but have omitted to notice whence taken.

The two finest pear-shaped Pearls known were those of Cleopatra, valued at 40,000 great sestercii, or 1,400,000 francs, about £58,333. Having dissolved one in vinegar she drank it, at a supper given to Antony, and wished to do the same with the other, which Antony prevented. This unique Pearl was taken to Rome, with the other treasures of the Queen, and Augustus having ordered it to be sawed in two, attached the halves to the Venus of Praxiteles, which was in the Pantheon; where they were still seen in the time of the Emperor Galienus. Cæsar, we are told, presented to Servilia, the mother of Junius Brutus, a Pearl which he had bought for £50,000. But Tavernier, the traveller formerly mentioned, is said to have bought at Catifa in Arabia, for the enormous sum of £110,000, a regular pear-shaped Pearl without blemish. Its diameter in the largest part was $\frac{63}{100}$ of an inch, and its length between two and three inches. I give you these statements as they are recorded, without vouching for their veracity.

I have said the formation of Pearls is supposed to be caused by the introduction of some foreign substance into the pearl-shell. A custom of the Chinese seems to corroborate this. In the beginning of summer, when the river muscles repair to the surface of the water and open their shells, the Chinese throw into them five or six small beads made of mother-of-pearl, strung on a thread. At the end of the year, when the muscles are drawn up and opened, the beads are found covered with a pearly crust in such a manner that they have a perfect resemblance to real Pearls. The truth of this, says Beckmann, in his "Inventions" cannot be doubted. It would appear

that several of the rivers of China produce Pearl-muscles, that they are accordingly fished for, and that all the Pearls thus obtained are the property of the Emperor. They are generally irregular in form and of bad colour; but as the Chief of the Celestial Empire has the choice out of the produce of many years, he is said to possess some fine chaplets.

Apropos of Pearls, the following story is related by Du Halde from a Chinese treatise on "Illustrious Women," which was written more than twenty-one centuries ago.

"A rich man named Tchu Yai lost his wife, and having but one little girl, married again. He had some fine Pearls (probably sea-pearls). He gave these to his wife, who had them made up into bracelets. Six years after this, Tchu Yai died in a foreign country. His wife, in the poignancy of her grief, threw away her pearl-bracelets. Her little step-daughter, then only nine years old, finding the Pearls on the ground, picked them up and placed them in the casket where her mother kept her mirror and other small objects not used by her during her mourning. When the relatives of the deceased heard of the death, they repaired to the widow to bring away the body of Tchu Yai, and bury it in the family sepulchre. On the road they had to pass a custom-house, and the law was death to any one who should be found introducing Pearls. The casket was inspected and the pearls discovered. The crime is evident, said the officer, but who is the guilty person? Tsou, the little girl, fearing for her step-mother, to whom the casket belonged, addressing herself to the officer said.—It is I who should be punished; I am

the only guilty one. How so? replied the officer; for he had to draw up a statement of the case.—She accordingly related to him what she had done. The mother being informed of the declaration of Tsou, ran immediately to her daughter to learn the truth of the matter. Tsou told her mother the truth, and added, that as the law ordered death, she alone should suffer the punishment. The mother believed her daughter's story, but, urged by tenderness and compassion, she flew to the officer—Stop, sir, said she, I entreat of you; my child is not guilty, therefore do not blame her, the pearls are mine, not hers. On the death of my husband I placed them in my casket: grief, care, and fatigue, had made me forget them; the fault is mine, let me be punished. No! exclaimed the child, with firmness, I put the bracelets into the casket. Not so! said the mother, it was I who did it: my daughter speaks as she does from affection to me, and to save me from the danger with which I am threatened. My lord, interrupted Tsou, out of compassion for me my mother accuses herself of a crime she has not committed, in order to save my life at the expense of her own. At length, as neither could overcome the other, they embraced, and by tears and sobs strove each to prevail. All the relations were moved with this scene; even the most disinterested spectators could not restrain their tears, and the custom-house officer let the act of accusation fall from his hands. He who presided at the tribunal also shed tears. Behold, said he, what a generous struggle, each striving to die for the other; as for me, I would rather die myself, if necessary, than condemn either! He then cast the Pearls on the

ground, and decreed, that this was one of those cases in which the guilty person could not be known, and dismissed the assembly. The procession moved on, and the story spreading, the generosity of the daughter and of the mother became a subject of universal admiration."

One more little episode, and I have done with Pearls. According to the poetic Orientals, every year, on the sixteenth day of the month of Nisan, the Pearl-oysters rise to the surface of the sea and open their shells, in order to receive the rain which falls at that time, and the drops thus caught become Pearls. On this belief the poet Sadi, in his *Bostan*, has constructed the following fable, whose moral is favourable to a becoming modesty.

"A drop of water fell one day from a cloud into the sea; ashamed and confused at finding itself in such an immensity of water, it exclaimed, 'What am I in comparison of this vast ocean? Certes, my existence is less than nothing in this boundless abyss!' While it thus discoursed of itself, a pearl-shell received it in its bosom; and fortune so favoured it, that it became a magnificent and precious pearl, worthy of adorning the diadem of kings. Thus was its humility the cause of its elevation, and by annihilating itself it merited exaltation."

If my pretty Cousin reflects on this when she puts on her pearls, they will read a lesson while they adorn her person. And now to a very different subject.

AMBER is one of those substances which have given rise to a great many different conjectures as to their origin. There is, however, every reason to

believe that it is a vegetable resin, solidified and mineralized by its sojourn in the earth and the action exercised upon it there by other substances. I have a theory of my own respecting it, which I think plausible, to say the least of it, but with which I will not trouble you.

Amber is a hard, light, and easily frangible substance. It is without taste or smell, unless it be heated, when it gives out a balsamic odour, peculiarly agreeable to most persons. By friction it becomes highly electric, attracting light bodies with great energy. Indeed, the name and science of electricity are derived from this substance, whose Greek name is *Electron*. Its specific gravity, according to some, is 1·065; according to others, 1·085. It is easily inflamed, and gives out a white smoke of a pungent odour; its lustre is vitreous, its texture resinous, and its fracture conchoidal; it scratches gypsum, and takes a good polish. Its colour varies from white, through various shades of yellow and orange, to deep reddish-brown; occasionally it is of a greenish-black; and in Sicily some is found of a peach-blossom colour, violet, and even crimson. It is translucent and opaque.

Its chief localities are the coast of the Baltic, in East Prussia, where it is cast up by the sea, into which it falls out of the neighbouring cliffs. It is also dug out of the cliffs themselves; and in certain parts of the interior of Prussia, pits are sunk for it to the depth of more than 130 feet; it is likewise found in the banks of some of the rivers, and in the sandy parts of Poland and Lithuania. It is found also in Spain and Sicily, Denmark, and the United States;

and at the mouths of the rivers Oby and Jennissei, and on the shores of the Frozen Ocean. Occasionally pieces are picked up on the Eastern coast of our own country, and in the gravel-pits near London. It is usually accompanied by lignite, and some of the specimens contain leaves, stalks, insects of different kinds, or their detached legs, wings, &c. enclosed in it; which clearly evinces its once fluid or viscous state. It is pretended that none of the insects thus found entombed in Amber can be referred to any living species.

Amber occurs in isolated masses, or nodules, of all sizes, from that of a nut to that of a man's head; these latter are, however, very rare; the usual sizes being from that of an egg to that of the fist. The largest piece of Amber known was found in Lithuania. It is preserved in the Cabinet at Berlin, and weighs 18 lbs.

Fine Amber is still much valued, particularly in the East, and accordingly the greatest portion of the Pomeranian Amber is exported to Turkey. The Prussian Government is said to derive an annual revenue of 17,000 dollars from Amber. A good piece of a pound weight fetches 50 dollars. A mass weighing 13 lbs. was picked up not long since in Prussia, for which 5000 dollars were offered, and which the Armenian merchants said would bring from 30,000 to 40,000 dollars at Constantinople.

In the East the principal use of Amber is for the mouth-pieces of pipes, and it is very extensively used for the same purpose in Germany, Poland, and Russia, &c.

Amber is also made into various ornamental

objects, as necklaces, ear-drops, vases, boxes, &c., and for inlaid work. There is, in one of the imperial palaces at St. Petersburg, a room entirely inlaid with Amber of every variety of colour, and sculptured in all sorts of forms; it is more curious and unique than pretty.

At one time Amber was fashionable, but the taste for it has passed away. The most transparent kind, of a fine yellow, was greatly prized in England and France, but not so in other places, where the semi-opaque kind, of a pale-yellow, diversified with veins and spots of dead-white, is the most highly valued, and is certainly the most beautiful.

Amber was well known to the ancients; and was obtained by them, as by us, from the Baltic. It must be concluded, from various ancient authors, that the Phœnicians penetrated into that (to them) distant Northern sea. According to Pliny, the Emperor Nero sent a Roman knight, named Julianus, to collect a large quantity of Amber, which he did; but it was all burnt in a single day at one of this madman's gladiatorial spectacles.

Besides the ornamental purposes to which Amber is applied, it is used in the preparation of superior varnishes, and, by distillation, a product is obtained from it which enters into the composition of some valuable sedative and antispasmodic medicines. Its powder, thrown upon a hot iron, is used for perfuming apartments, and is occasionally put upon the coals of the warming-pan for airing the beds of persons afflicted with rheumatism.

Æschylus, the Greek poet, who is supposed to have invented the fable of Phaeton, lived 2316 years

ago, and he knew of Amber. This ambitious young gentleman, I mean Phaeton, not Æschylus, must needs, as you know, conduct the chariot of the Sun, lose his own life, and set the world on fire. His sisters, the Heliades, mourning over the tomb of their unfortunate brother were changed into poplar-trees, and their tears into amber. Ovid sung of this, and Desaintange has thus translated the passage:—

> "Sous leur forme nouvelle elles pleurent encor:
> L'ambre de leur ramaux distille en larmes d'or.
> Au feu de ses rayons le soleil les épure,
> Et la jeune Romaine en forme sa parure."

Turquoise, or *Callaite.*—There are two kinds of Turquoise, one of which, called by us *Oriental*, and by the French *Turquois de Vielle Roche*, is a real stone, and is classed by some mineralogists as a hydrated Silicate of Copper, though others affirm it to be a particular mineral. The other kind is nothing more than tooth or bone coloured by a metallic oxide. The first kind is by far the more precious. Its chief colour, which it owes to copper and iron, is a beautiful sky-blue; sometimes this is pale, and it sometimes passes through shades of greenish-blue into bluish-green. It is quite opaque, except perhaps on its very thin edges, which are occasionally translucent. Its texture is perfectly compact, and its fracture uneven. It is brittle, about as hard as felspar, and takes a good, though not a brilliant polish. Its specific gravity is from 2·8 to 3, and its streak is white. It is found in the neighbourhood of Nishapúr and Firozkuh, in Persian Khorassán, and also at Mount Phirous, between Hyrcania and Parthia, four days' journey from the Caspian. It occurs as rolled peb-

bles, or in small veins in its original repository, traversing a kind of trap. These Persian stones are the most apt to turn green. All that is found belongs to the Government, which farms the right of searching for the Turquoise, to the highest bidder; the sum amounts annually to £2000 or £3000.

The beauty of the Turquoise consists in the purity of its fine blue colour. This stone is usually cut *en cabochon* or oval, and must be quite free from specks or veins. An Oriental Turquoise of 5 lines by 4½ is valued at about £10.

This stone has been sometimes engraved, but only by the moderns. Brard mentions a fine suite of twelve Turquoises about the size of the nail, all alike in dimensions, form and colour, on which were engraved the heads of the twelve Cesars. It was sold for 9,000 francs, about £375. The Cabinet of the Grand Duke of Tuscany is said to possess a beautiful Turquoise, on which is engraved a head of Christ; but whether it be an Oriental Turquoise or not, I am unable to say.

The Occidental Turquoise is either fossil ivory, or bone, which is coloured by phosphate of iron, and has acquired great hardness. This kind is easily distinguished from the other by its effervescing with acids, and giving out a fetid odour when heated. Sometimes a close inspection with a magnifier will detect the organic structure. Its specific gravity is also inferior. It may be electrified by friction without being insulated, and retains its electricity for several hours, which is not the case with the Oriental Turquoise. This is an excellent test for such stones as are mounted. The bone Turquoise perfectly re-

sembles the other in colour and appearance, but loses its freshness and vivacity by humidity. This kind is found near Simore, in the department of Gers, in France, and in several parts of Germany.

There is, or was, many years ago, in the British Museum, the skeleton of a hand, the bones being in great part converted into Turquoise.

The value of an Occidental Turquoise is less than half that of an Oriental one, when both are alike in size and colour. If the colour be pale, it is much less. A bone Turquoise of 4 lines by $3\frac{1}{2}$ only fetched £2.

The ancients knew both kinds of Turquoises. It is said they did not engrave upon them; but wore them as amulets, fragments of which are still found in the ruined cities of Upper and Lower Egypt. Nevertheless, Mr. Poujet, jun. speaks of a Turquoise of four inches, representing an Egyptian divinity, and which he says is of the highest antiquity.

The Turquoise was one of the stones in the pectoral of the High-priest of the Jews.

This stone should be set round with small brilliants or with pearl. It has lately been extremely fashionable in jewellery.

LETTER XXXIII.

Petrifactions—Incrustations—Casts—Impressions.

THE task you had imposed upon me, my dear Florence, and which has so far been most agreeable to me from the pleasure and instruction you say you have derived from the perusal of my letters, is now drawing to a close. There only remains the promised article on *Peat;* but as I have no time to write it to-day, I will in the meanwhile just send you a very few words on a subject regarding which most persons are eternally making mistakes; for I wish you to have, as far as possible, correct notions on everything you may have occasion to speak about.

Every organized body that has undergone a change by which it acquires the appearance of a stone is called, by ignorant people, a *Petrifaction.* Now you must understand that there are *Petrifactions*, *Incrustations*, *Casts*, and *Impressions.* To explain this I must borrow from myself, and repeat here what I have said elsewhere.

A Petrifaction is a body, which, with all the appearance of being organic, is actually converted into a mineral mass, the original organic matter having partially, or wholly disappeared, or been changed. The precise manner in which the metamorphosis is effected is not exactly understood; but we may say, generally, that it is by one or other of the following modes. First, by *Intromission* of the mineralizing matter into the original interstices, pores, or cavities of the organized body. Second, by *Substitution;* the

mineral matter by degrees replacing the organized substance, as the latter disappears; or thirdly, by *Impregnation* and *Consolidation* of the organized substance itself, chemically changed. In all three cases, the fossil body, while it retains its organic appearance, such as the fibres in the case of wood, &c., is in reality converted into a mineral, different according to circumstances.

The mineral substance of Petrifactions in general, is either calcareous, siliceous, or argillaceous. Of those that are calcareous, by far the greater part are carbonates; for although fluate of lime sometimes serves as a matrix, it rarely forms the substance of the petrifaction. Sulphate of lime occasionally lines the cavities left by destroyed fossils, but does not itself form them. Sulphate of barytes hardly ever forms petrifactions. The matrix of fossils is not unfrequently silex, quartz, agate, calcedony, jasper, pitchstone, semi-opal, and alumina; the latter substance often enters into the composition of the fossil. Bituminous slate and the argillaceous iron-ores are often fossiliferous. Sometimes, but very rarely, fossils are found in Fuller's-earth. It is said that hornblende sometimes forms the nucleus of fossil shells, and that fossil animals and vegetables have been discovered in substances which have been mentioned, as basalts, wackes, and trap.

Of the metals which contribute to the formation of fossils, the most common are iron and copper, rarely lead or zinc, and still more rarely silver; they are generally carbonates or sulphurets. The carbonates and sulphurets of iron are most common in fossil vegetables; the specimens of wood mineralized

by copper, often possess a degree of beauty which causes them to be prized by reason of the brilliant colour which the malachite communicates to them. Sulphuret of lead has been found in petrified wood. Blende, or sulphuret of zinc, is sometimes found with crystals of quartz, in the interior of fossil shells; it is even said that silver forms a fossil resembling an ear of wheat in the mines of Frankenberg in Hessia. Fossil fruits converted into iron pyrites are found in the clay of the Isle of Sheppey.

INCRUSTATIONS are formed by a deposition of stony matter, and when this covers organic bodies all over but thinly, the forms are preserved, and the substance, in some cases, appears as if really petrified: these Incrustations are sometimes siliceous, but more frequently they are calcareous. Incrusting springs are by no means uncommon; among others, there is a very celebrated one called of Saint Alyre, at Clermont Ferrand, in France. It forces its way through kitchen-gardens, and the proprietors of these have made the spring construct for them, at no expense, a wall of separation between their respective properties, which wall is 240 feet long, 16 high, and of considerable breadth. Besides this, they subject various small animals and plants to the incrusting process. Thus for a fine bunch of fresh juicy grapes, they will give you a coated one, which looks like grapes sculptured in brown stone, and for a fine cabbage, fit to put into the soup, they offer you in exchange, what you would mistake for a beautiful and delicately cut imitation of the same in stone.

CASTS.—Whenever an aquatic body is enveloped in a pasty mass, which subsequently hardens, if any-

thing causes the destruction of the enclosed body, a cavity or mould is the result; if now any substance enters this cavity so as to fill it and then hardens, a re-integration of the form of the organic body is effected, and such formation is called a *Cast;* it being, in fact, produced by nature in a way similar to that of forming Casts by art. These Casts may be either of the same substance with the mould, or of a different substance; in the former case, they are regarded as nearly contemporaneous with the formation of the mould, and in the latter case as more modern.

IMPRESSIONS.—Flowers, leaves, the wings of insects, &c., are too delicate to resist destruction for any length of time; they, however, leave their Impressions, which are frequently found in certain slates, indurated clays, argillaceous iron-stones, tufas, &c.

Of real petrifactions, those where beautiful woods are silicified are the prettiest; they are very hard and take a brilliant polish. Petrified palm-tree is exceedingly pretty; it is cut into slices for snuff-boxes and similar objects. I trust that you will now be in no danger of calling an incrusted frog a petrifaction, and will understand that what are so often called petrified shells, are mere casts.—My next on Peat, and now adieu!

LETTER XXXIV.

Peat—Fibrous Peat—Papyraceous Peat—Earthy Peat—Piciform Peat.

IN performance of my promise, I now sit down to give you a brief account of *Peat*. Going, as you are about to do, to a part of the country where peat-mosses abound, it is very natural that an enquiring mind like yours should feel anxious to know something regarding those marshes which, to a certain extent, compensate for their sterility by supplying a cheap and abundant fuel.

Peat is a substance that is in an intermediate state between the vegetable and the mineral. Beginning with the first rudiments of change from the perfect vegetable, it is found successively of a more mineral character till it shades into a hard, compact, black lignite, very analogous to coal.

This substance is found more particularly in northern climates, where it exists in various countries in immense patches, sometimes of many square miles. Thus, one-tenth part of the whole surface of Ireland is covered with Peat. On the Shannon there exists a Peat-bog, which, according to Dr. Boate, is fifty miles long and two or three broad; and on the Loire, in France, there is said to be one of fifty leagues in circumference. But if there are very large surfaces of Peat, it also exists in very small patches; and there is just as great a diversity in the depth as in the superficial extent. In some cases, the thickness of the bed of Peat is very trifling, in others it is

more than forty feet; nor is it confined to low places or horizontal positions. There are formations of Peat in very elevated parts of the Alps and elsewhere, and on the declivities of mountains. The Bloksburg or Bruchberg, the highest mountain of the Hartz, has Peat on its summit. Peat also differs in its quality, not only as taken at the top or bottom of the same deposit, but also by reason of the vegetables of which it is composed in different countries; vegetables which in all cases are those of the present growth of the country where the peat is found. When, besides all this diversity, we further consider, that all marshes do not contain Peat, the question naturally arises, What is essential to the formation of this substance?—a question to which I regret, dear Florence, that I cannot give you any satisfactory answer.

As Peat has never been found within the tropics, and abounds most in those countries that are farthest removed from the equator, and as it occurs only where water is stagnant, it would seem that cold and moisture are essential to its formation.

Stagnant waters give rise to an abundant growth of certain cryptogamous and herbaceous plants of a loose spongy texture, which annually decay; now when such decay takes place in hot countries, decomposition is so rapid, the carbon of the vegetables is so speedily converted into carbonic acid, that no time is allowed for that peculiar process by which, in colder climates, the decayed vegetables are converted into Peat. The water itself becomes impregnated, by the infused vegetables, with a quantity of extractive matter, and as none of this is dissipated by heat

in the colder regions, it has time to effect slow chemical combinations, the nature of which are not well understood, but which are probably necessary to the formation of Peat.

As a peculiar aquatic plant, the *Sphagnum Palustre*, is abundant in many peat-mosses, the existence of Peat has often been attributed to the presence of this vegetable; but that it is not essential, is evident from the fact that some Peat is composed wholly of leaves, as is the case below Maestricht on the Meuse. In the Jura there is Peat formed exclusively of the leaves or spines of resinous trees. In the Dunes of North Holland there exists a very good Peat formed solely of sea-weed (the *Fucus Digitatus*).

From these facts it would appear that neither the *Sphagnum Palustre*, according to some, nor the *Conferva Rivularis*, according to others, nor indeed any plant in particular, is essential to the formation of Peat, which to this day remains a mystery.

It appears, however, that, in many cases at least, no very great length of time is necessary for the formation of Peat. According to some, a whole century is required, according to others, a much less time. Both may be correct, for, under different circumstances, a longer or shorter period may be necessary for the process. It is however certain, that Mr. Van Marum observed a bed of Peat, of five feet deep, to be formed at the bottom of a basin in his garden in the course of five years.

It is also certain that many existing peat-mosses were forests, in comparatively modern times. These forests, whether blown down, as that near Lochbroom in Ross-shire, or felled purposely, as those of Hyrca-

nia, the Ardennes, &c., by order of the Emperor Severus—or our own English, Welsh, and Irish woods, destroyed by command of our monarchs, as harbouring wolves and outlaws—these forests, I say, being levelled and the trees remaining on the spot, have been favourable to the stagnation of water, and the converting of their sites into peat-bogs. Indeed, fifty years after the forest of Lochbroom was blown down the inhabitants dug Peat there. The former existence of the forests is attested by the trees still found buried in the Peat. In Hatfield moss, fir-trees have been found ninety feet long, which have been sold for the masts and keels of ships; and mention is made in the Philosophical Transactions, of an oak from the same moss, of larger dimensions than any tree now existing in the British dominions.

Other circumstances besides the discovery of buried trees in the Peat, prove its comparatively modern formation. Mr. Lyell tells us, that in the moss of Hatfield just mentioned, as well as in that of Kincardine and several others, Roman roads have been found, covered to the depth of eight feet by Peat. All the coins, axes, arms, and other utensils found in British and foreign mosses, are also Roman; so that a considerable portion of the European Peat-bogs are evidently not more ancient than the age of Julius Cæsar: nor can any vestiges of the ancient forests described by that general along the line of the great Roman way in Britain be discovered, except in the ruined trunks of trees in the peat.

There are various kinds of peat, as the *Fibrous*, the *Papyraceous*, the *Earthy*, and the *Piciform*.

The first of these is the most common, and con-

sists of an entangled mass of fibres, which are the roots and stalks of the vegetables changed in their nature. The second kind is wholly composed of leaves or of vegetables, so arranged as to present a compressed mass of sheets of peaty matter: this kind occurs in Sicily. The Earthy has a compact appearance like what is termed *humus*, or black vegetable mould, in which the plants can no longer be detected; it is sometimes nearly solid, and sometimes like a thick mud. The Piciform is always compact, and has a resinous and shining fracture. It is rare.

The first and third kinds exist together in a single peat-bog, if it be a deep one. On the upper surface the peat is hardly formed; as you descend it is found in a more perfect state, and at the bottom the vegetable tissue is no longer discernible. This gradation is easily conceived: the bottom peat was the first formed, it has therefore had a longer time to effect the necessary change; it is blacker in colour, and being compressed by the superincumbent weight of all that lies over it, is proportionally compact.

The peat of the valleys is occasionally interstratified with beds of sand and fresh-water shells, according as sand has been drifted over it, (a very common occurrence in Poland,) or as they have been covered with water long enough at a time for the growth and development of fluvial and lacustrine molluscs.

Besides the trees and various objects of human industry already mentioned as occurring in Peat-bogs, (the former being sometimes so blackened as to resemble ebony,) it is no uncommon thing to find embedded skulls and horns of oxen and stags, the last sometimes of extraordinary dimensions.

It is remarkable that while Peat, from its elasticity, casts up to the surface any light body driven into it, as for instance a pile of wood, it swallows up heavy bodies; thus axes, stones, or other heavy objects left or thrown upon the surface of a Peat-bog, become soon buried; not that it is covered with fresh matter, but it gets gradually ingulphed.

The springiness of Peat is very sensible, and a person jumping upon a part of a Peat-bog will shake the whole for a great way round. The Dutch are enabled by the elasticity of the Peat to leap ditches eighteen feet wide. This property is greatly increased if there be water under the Peat. In this case, the Peat is sometimes actually floating on the water, and when large masses of it get detached they are driven about by the winds, forming floating islands.

Peat-bogs are particularly dangerous when the surface is dry; for in that case nothing indicates the danger, and persons walking over them sink to rise no more. Take care then, dear Florence, that in your botanic ardour to seize some flowering plant, you do not venture on these treacherous spots.

Peat has a very peculiar property, by which it preserves for a long time animal bodies buried in it. This may either be owing to some antiseptic principle it possesses, or because it surrounds the bodies with an astringent matter that protects them from the contact of the air without destroying them, and by its soft and elastic state secures them against shocks by which they might be injured.

There is a pyritiferous Peat, which, as its name indicates, contains a quantity of iron pyrites; it is

also mixed with shells, and contains beds of sand and clay, and is covered by a bed of chalk. This kind is never covered with water, but is traversed by it in its lowest parts. It belongs more especially to elevated plains. It is rare, and known only in the North-eastern part of France.

The sea, as well as the land, produces a kind of Peat; great beds of a soft, brown, spongy mass, the result of a decomposed marine vegetation, occur in front of the rocks of Calvados, on the French Coast.

I need hardly describe to you the mode in which Peat is dug, as you will have abundant opportunities of seeing the operation. The summer is the best time for digging and drying it. The bog is drained by ditches cut in the Peat in such a way as to carry off the water, and then the Peat is dug by a spade of a particular form, which cuts it into brick-shaped pieces, varying in size in different places. These are laid out to dry and are then stacked, and covered with a roof to keep off the wet. When the Peat is a wet, humus-like mass, it is *dragged* up, allowed to drain, and then shaped in moulds and dried.

In some places, excellent rich land is found below the Peat at no great depth, and, where the locality permits, the Peat is cut into large cubical masses, that are floated off first by the ditches, and then by the rivers into which these open, to be by them carried away to sea. In this manner some estates have been greatly increased in value.

The sole use of Peat is for fuel, particularly where wood and coal are wanting or are dear. This is the case in Holland (which without Peat would be unin-

habitable), Hanover, and other parts of Germany, Ireland, parts of Scotland, &c.

The moulded Peat is the best, it burns slower, and gives out greater heat than the less compact kinds. It is used like wood in houses and for manufactures. It is not easily lighted, but when once on fire, it burns steadily till all is consumed. It answers very well for burning lime, bricks and tiles, and for distilleries, &c.

Peat has been reduced to charcoal by the economical and simple process of suffocation, and also by distillation, or burning in closed vessels.

Attempts have been made to use Peat both in its natural state and as charcoal for metallurgical purposes; and in some cases has been found to answer.

The pyritiferous Peat burns very badly and gives out an abominable odour; but being burnt upon the spot, and its ashes lixiviated, they furnish sulphate of iron and alumina. It has been asserted that the ashes of this kind of Peat, mixed with water, yield a better hydraulic cement than even that made with puozzolana.

Burnt Peat is considered a good manure for certain soils. When Peat is completely saturated with water, it will admit of no more, and advantage has been taken of this in Sweden and Norway for the formation of dykes. The Peat, nearly dry, is beaten in between two walls: if any water gets in, it swells the Peat, which then resists the passage of any more fluid, as perfectly as clay could do.

Faujas says, that in Carinthia there is a kind of fawn-coloured, filamentous Peat, which the inhabitants mix with wool and work up into common cloth.

Finally, I will merely add that bog-iron ore occurs in the Peat-marshes, as also sometimes very pretty specimens of the blue phosphate of iron.

This, dear Florence, was to have been my last, but I will yet send you a few words on the use of stones as *souvenirs*, &c.

LETTER XXXV.

Talismans—Hieroglyphic Rings—Table of Stones.

IN some of the preceding letters, my dear Florence, I have had occasion to mention, that in former times certain virtues were attributed to particular stones, sometimes plain and sometimes engraved; both, but especially the latter, were Talismans. To go into the history of these would be a long affair, and foreign to my purpose. Should you wish to know more upon the subject than I can enter upon here, you must use your industry among the books of the excellent library to which you have access.

Talismans were of different kinds in different countries, and even in the same country. Some were astrological, some magical, and some of a mixed character. They were formed of stones and metals, possessing an imagined relation or analogy to the particular objects of the talismans, and engraved with figures and superstitious words. The very time of engraving was of importance to their efficacy, particularly in regard to those that were astrological. Their object was to place the persons who wore them under the benign and protective influence of certain stars and constellations, and accordingly the position of the heavenly bodies, at the time of preparing the talismans, was particularly attended to, and many superstitious ceremonies observed. But whatever their nature, the purport of them all was to secure those who had faith in and wore them, from diseases, and from the malice of demons and

evil spirits, to whose machinations, misfortunes of every kind were imputed.

Talismanic influence was not, however, confined to such engraved stones, nor limited in its efficacy to individuals; other objects were employed, as images, writing, &c., and these preserved in houses were considered a safeguard to all their inmates, or, deposited in temples, were thought to secure whole cities from plague, pestilence and famine, conquest or conflagration.

When once the belief in the power of such inanimate objects had taken firm hold of men's minds, we are not to be surprized at the value set upon them. Every individual would protect himself from harm, be invulnerable to all malefices, and secured against every effort of malignant fortune, and every town would, in like manner, seek safety under some talismanic protection. And thus, though the origin of Talismans is of the highest antiquity, the belief in their virtues has existed to very recent times. Their character and nature have changed with time and circumstances. The Egyptians used images of their gods and sacred animals, as the ibis, the scarabæus, &c. The Greeks used little tablets inscribed with Ephesian words, and believed in the efficacy of the Palladium. The Romans had their household gods, and wore various idols suspended round their bodies by chains. The Arabians and other Mohammedan people wear stones engraved with sentences from the Koran, and even slips of paper, with similar sentences written upon them, inclosed in armlets and other ornaments. Among savages, the *Fetish*, and among the American Indians, the *Medicine*, afford talismanic protection.

Would I could say that the Christian religion and the lights of reason and science had completely banished from the earth all such superstitious beliefs. There still exists in the human mind a lingering fondness for mystery and a large amount of credulity. But I do not mean to touch upon a very delicate topic into which this subject might naturally lead me; I will therefore confine myself to precious stones, plain and engraved, and worn as Talismans were formerly, and endeavour to shew that, while it is absurd to attribute supernatural efficacy to such objects, they may innocently be made the means of an agreeable and sometimes useful association of ideas.

Talismans of the kind to which I allude were introduced into Europe by the Moors when they settled in Spain, and so late as two centuries back, they were still in high and general esteem in France and Germany.

It is well known to you that the pectoral of the High-priest of the Jews was studded with twelve gems representing the twelve tribes. Well, about two hundred and fifty years ago, the Germans, taking the hint from this, invented a suite of twelve stones to correspond with the twelve months of the year. The analogy between the stones and the months they severally represented, is by no means equally evident throughout the series, nor is it easy to see upon what principle the selection was made. But be this as it may, each stone had engraven upon it the sign of the month to which it belonged. The following is a table of these talismanic stones :—

Months.	Constellations.	Signs.	Stones.
January.	The Waterbearer.	♒	Jacinth or Garnet.
February.	The Fishes.	♓	Amethyst.
March.	The Ram.	♈	Bloodstone.
April.	The Bull.	♉	Sapphire.
May.	The Twins.	♊	Emerald.
June	The Crab.	♋	Onyx-agate.
July.	The Lion.	♌	Cornelian.
August.	The Virgin.	♍	Sardonyx.
September.	The Balance.	♎	Peridot or Chrysolite.
October.	The Scorpion.	♏	Aquamarine.
November.	The Archer.	♐	Topaz.
December.	The Goat.	♑	Turquoise or Malachite.

These stones were fashionable, and many persons of both sexes wore, mounted in rings, the stone of the month in which they were born. I will not say that some mystical and foolish notion was not often attached to the practice; but I do not see why such stones may not be worn in memory of happy events, or as calling up agreeable associations. The month in which a lady was wedded to the object of her affection—the month that ushered into the world her first-born, the month passed in the country with a dear friend, or any other similar event, may be recalled to mind by such a *memento* as one of the above stones; and a present of this kind could not fail to be more highly prized than a jewel having no meaning attached to it.

It is well known that colours are emblematical, and those of stones may call up ideas as well as those of flowers or of stuffs. Pope Innocent III. sent to our King John, four rings; these were emblematical as to their colour. One was an emerald, denoting

faith ; one a sapphire, *hope ;* one a garnet, *charity ;* and one a topaz, *good works.* Now why should not all four of these stones be set into one ring, and remind the wearer of the jewel, of those Christian duties, the performance of which will eventually secure a much more priceless jewel—a crown of glory ?

The Diamond is a fit emblem of purity. A lamented friend, whose practice it was to present his wife, annually on her birth-day, with some little token accompanied by familiar verses, gave her on one of these occasions a diamond hoop-ring, to which, in the lines that accompanied the present, he alluded in these words :—

> Accept my dear ———, though not now in my youth,
> An off'ring to love, and a pledge of my truth—
> Of truth never broken, of love unimpair'd,
> Supported by fondness and mutual regard.
> 'Tis a ring set with brilliants, fit present from me,
> An emblem of love, or what love ought to be.
> Of nature's rich products, well form'd to endure,
> 'Tis endless, united, 'tis spotless and pure.
> . . . .

A lively imagination is ever fond of seeking similitudes, and when these are found, inanimate objects become emblematic, and awaken ideas that would otherwise lie dormant.

Some objects are better suited than others to answer the purpose of emblems. In stones there is little beyond their colour and brilliancy, or in a few cases perhaps some remarkable property that may be emblematical ; but when combined with form, arrangement, setting, engraving, &c., they may consti-

tute objects which, besides their intrinsic beauty, may have a meaning and speak a language. A lady of my acquaintance whose name was Rose, gave her friend, not a brilliant but a rose-cut diamond, and which, from the name, was more valued than a brilliant would have been. A Turquoise would, in like manner, call up the name of *Celeste*, common enough in France. An *Aquamarine* would be a fit stone to be presented by a seafaring person. A deep-blue *Sapphire*, from its colour, is, as we have seen in the case of the rings sent to King John, an emblem of hope: true blue is generally with us the emblem of constancy, it will therefore do either for that virtue, or for the name Constantia, &c.

Stones are sometimes cut or set in various forms, as hearts, crosses, bows or true-lover's knots, &c.; but there is often as little taste as imagination or appropriateness in these objects. The white calcedony with red spots, called St. Stephen's stone, and which has been mentioned in a former letter, may be cut into the shape of a heart, and be emblematic of a heart that is pure but sorrowful: (white has ever been emblematic of innocence). Satin-spar, or silky malachite, or wavy natrolite, or the compact fibrous asbetus, are much fitter materials to work up into true-love knots and bows, than Jasper, which is now so common. I have seen satin-spar and malachite both employed together in the formation of a snuff-box: now no one would think of keeping snuff in silk or satin. It would be much more appropriate to make such a box of silicified wood. An acquaintance of mine has had some relics of the heroes Nelson and Wellington mounted in a brooch, and surrounded by

a wreath of laurel and oak. This wreath is cut in a fine malachite: nothing could be more judicious. These hints will be sufficient for you to understand what I mean by appositeness or appropriateness.

Hieroglyphic Rings were, immediately after the battle of Austerlitz, very fashionable. That battle was called the battle of the three Emperors, in 1805. Three rings, each with a different coloured stone, were bound together by a gold chain, and this jewel was called the *ring of the triple alliance.* Then came the hieroglyphic rings, in which a name or word is spelt by the initial letters of the names of the stones forming such rings. I will give you, before I close this letter, a list of stones in alphabetical order, in case you should feel inclined to have any set in this way; and as in some names and words the same letter is repeated, I will give you, as far as I am able, more than one stone for each letter, in order not to repeat the stone, and that the opaque and the transparent may be occasionally blended.

Besides these hieroglyphic rings, brooches, bracelets, &c., there are many other objects in which jewels may be fancifully applied. Thus, much pains are taken to adorn ladies' watches; now as every one knows the position of the hours on the dial, why not replace the figures or numbers by stones? Suppose four diamonds to stand for 12, 3, 6, and 9, with coloured stones for the other hours: or suppose all the twelve hours to be represented by as many different stones, whose names begin with the same letters as the names of the respective numbers. For one, an Onyx; for two, a Turquoise; for three, a Topaz; and so on all the way round. Or the twelve stones

may give as many initial letters as will form some sentence relating to time, as—WE PASS WITH IT—THE TIME FLIES, &c; or again, they may form the name or names of the giver of the watch, if such name be composed of twelve letters, or of eight, by using four diamonds for the quarters of the horary circle. Eleven stones will make up the words FORGET ME NOT, and the twelfth stand for the initial of the name of the person desiring to be remembered. A skilful jeweller could arrange all this with much taste. I would have a slightly-raised garland of coloured gold and of appropriate breadth run round that part of the dial where the numbers are placed, and each stone, in its exact horary position, should be the centre of a flower. Or again, leaving, if desired, the numbers as they now stand, why not, in place of pearls or small diamonds, have a full hieroglyphic circle of coloured stones expressing some names, or a sentiment, or moral sentence?

I confess I like to see a meaning in everything, not excepting trifles: but I have said enough; you may now give free scope to your imagination, which will no doubt suggest numberless instances in which the hint I have given may be carried out. My object is merely to shew you that stones may have a meaning attached to them, and, as such, be worn as amulets or talismans, having the virtue, not of operating miracles, but of calling up pleasant or useful associations of ideas.

I now proceed to give you an Alphabetical Table of such stones as may be used for the purposes I have mentioned.

LIST OF STONES

THAT MAY BE USED FOR HIEROGLYPHIC RINGS, BROOCHES, ETC.

In this List T. means Transparent; t. Translucent; O. Opaque; o. Opalescent; I. Irised; M. Metallic lustre; A. Avanturined.

A

Minerals.		Colours, &c.
Amethyst	T.	Violet of various tints and shades.
Amber	T.t.O.	Yellow, Orange, Black, Brown, Red.
Agate	t.	Various Colours; Uniform, Striped, Spotted, &c. See *Onyx.*
Asbestus	t.o.	Green.
Asteria	T.o.	Red, Blue, Yellow.
Adularia	T.o.	Colourless. See *Felspar* and *Moonstone.*
Azure Stone	O.	Lavender- and Ultramarine-blue. See *Lapis Lazuli.*
Aquamarine	T.	Sea-green. See *Beryl.*
Avanturine	O.t.A.	Different tints. See *Quartz* and *Felspar.*
Amazon st.	O.	Verdigris-green. See *Felspar.*
Actinolite	T.t.	Green of various shades.
Agaphite	O.	Blue. See *Turquoise.*
Almandine	T.	Fine dark Red. See *Garnet.*
Aplome	t.	Reddish-brown. See *Garnet.*
Arendalite	t.O.	Green, &c. See *Epidote.*
Axinite	T.t.	Clove-brown, Violet-green.
Automalite	O.	Greenish-black. See *Gahnite.*

B

Beryl	T.	Blue, Yellow, Green, various tints of each. See *Aquamarine.*
Bloodstone	O.	Dark-green with red spots. See *Jasper.*
Bronzite	O.M.	Pinchbeck-brown, and Ash-grey.
Baikalite	t.	Green, (a variety of Pyroxene).
Balas Ruby	T.	Red. See *Spinelle.*
Boracite	T.	Colourless.
Brookite	T. t.	Brown, Yellow.

C

Minerals.		Colours, &c.
Cinnamon-st.	t.	Hyacinth-red and Yellowish-brown. See *Garnet, Zircon, Hyacinth,* and *Jargoon.*
Cairngorm	T.	Yellow, Orange, Smoky of various tints and shades.
Carbuncle	T.	Red, like a burning coal. See *Garnet.*
Chrysolite	T.t.	Green of different tints. See *Peridot* and *Olivine.*
Cornelian	t.	Orange-red of various tints, besides *Sarde;* which see.
Calcedony	T.t.	White of different tints, also pale-lavender- and smoky-grey.
Cachalong	O.	Dead white, somewhat yellowish.
Chrysoberyl	t.o.	Green of different tints.
Chrysoprase	t.	Apple-green.
Crystal	T.I.	Colourless. When coloured, has specific names. See *Quartz.*
Cat's-eye	O.t.o.	Brown and Grey.
Chrysocolla	t.O.	Green, Bluish-green.
Colophonite	T.t.	Yellow, (a variety of Garnet).
Condrodite	T.t.	Honey-yellow, Reddish.
Cordierite	T.t.	Blue. See *Iolite.*
Corundum	T.t.O.	Blue, Red, Brown. See *Sapphire* and *Ruby.*
Cyanite	T.t.	Blue. See *Kyanite.*
Cyprine	T.t.	A Blue variety of *Idocrase.*

D

Diamond	T.t.	Colourless, but by refraction. Rarely Blue, Pink, and Black.
Diallage	O.M.	Olive-green and Emerald-green. See *Smaragdite.*
Dichroite	t.	Dull Violet-blue. See *Iolite.*
Disthene	T.t.	See *Kyanite.*
Delphinite	T.t.	Green, Yellowish-green. See *Epidote.*
Devonite	t.	Green, White, in radiated lines. See *Wavellite.*
Diopside	T.t.	Green of various shades, (a clear variety of *Pyroxene*).
Dioptase	T.t.	Fine Emerald-green.

E

MINERALS.		COLOURS, &c.
Emerald	T.	Grass-green.
Epidote	T.t.O.	Dark-green and Yellowish-green.
Essonite	O.	Brown, Yellow. See *Garnet*, (it is the Common *Cinnamon-stone*).
Egerane	t.O.	A Brown variety of *Idocrase*.
Elaolite	t.O.I.o.	Bluish-green, Irised, and Opalescent.
Euclase	T.	Pale-green, Colourless. It is almost too brittle to be employed in jewellery.
Eudialite	t.O.	Brownish-red, Rose-red.

F

Felspar	T.O.A.o.	White, Yellow, Green, Blue, Grey, Black. See *Adularia*, &c.
Fluor Spar	T.t.	All colours and tints.
Flos-ferri	t.O.	Pearly-white, (a variety of *Arragonite*).
Frugardite	T.t.	Yellowish-green. See *Idocrase*.

G

Garnet	T.O.o.	Columbine-red, Cherry-red, Blood-red, &c., besides other colours under particular names. See *Melanite*, *Vermeil*, *Essonite*, &c.
Girasol	t.o.	Bluish-white, with yellow or red play of light. See *Opal*.
Gadolinite	O.	Brilliant Black.
Gahnite	O.	Dark Greenish-black.
Glaucolite	t.	Lavender-blue, Bluish-green.
Grammatite	T.t.	Clear-green. Colourless, (a variety of *Hornblende*).

H

Hyacinth	T.t.	Red, Brown, Yellow, Greenish, and Yellowish-white and Green. See *Jargoon* and *Zircon*.
Heliotrope	O.t.	Green of different tints, sometimes with Red spots. See *Bloodstone*.
Hauyne	T.t.	Bright-blue, rarely Bluish-green.
Hydrophane	t.	A variety of *Opal*.
Hyperstene	t.O.M.	Dark-green, Bronze-red, with a Metallic-pearly lustre.
Hyalite	T.	Colourless, (a variety of *Opal*, but without iridescent colours.)

I

Minerals.		Colours, &c.
Iolite	T.t.	Dull Violet-blue.
Iris	T.I.	Colourless, with coloured Opalescence. See *Quartz* and *Crystal.*
Igloite	t.O.	Pearly-white, with wavy lines, (a variety of *Arragonite*).
Indicolite	T.t.	Azure-blue, (a variety of *Tourmaline*).
Idocrase	T.t.	Orange-red, Yellow, Green, Brown, &c. (It is often set as a *Garnet* by Jewellers and Lapidaries).

J

Jargoon	T.t.	See *Hyacinth* and *Zircon.*
Jade	O.	Green of various tints.
Jet	O.	Velvet-black.
Jasper	O.	All colours and shades, uniform and variegated. Green with red spots. See *Bloodstone.*
Johnite	O.	Blue. See *Turquoise.*
Jurinite	t.	See *Brookite.*

K

Kyanite	T.t.	Blue, White, and Grey.
Kirghisite	T.t.	Green. See *Dioptase.*
Klaprothine	t.O.	Azure-blue. (It has sometimes been confounded with *Lapis Lazuli,* under the name of *Lazulite,* but is quite a different mineral).

L

Lapis Lazuli	O.	See *Azure-stone.*
Labradorite	O.t.o.	Dark-grey with bright blue, green or copper-coloured opalescence. See *Felspar.*
Ligurite	T.t.	Apple-green.
Leucosapphire	T.t.	Pale-blue. See *Quartz.*
Latialite	T.t.	Blue. See *Hauyne.*
Lazulite	t.O.	Blue. See *Klaprothine* and *Lapis Lazuli.*
Lepidolite	O.t.	Pink or Rose-red. (It is sometimes turned into beads for pins, and cut into small ring-cases; but is almost too soft for the purposes of jewellery).
Loboite	T.t.	See *Idocrase.*

M

Minerals.		Colours, &c.
Malachite.	O.	Green of different tints and shades.
Marcasite	O.M.	Steel-grey and Brass-yellow, (it is a metallic ore).
Moon-stone	T.t.o.	White. See *Adularia* and *Felspar*.
Marakanite	T.t.	Smoky-grey or Yellow (see *Obsidian*), often in banded colours.
Melanite	O.	Black. See *Garnet*.
Manganese Spar	O.	Red, Pink.
Mellilite	t.O.	Pale Yellow.
Mocha-stone	T.t.	Calcedony, containing moss-like or dendritic delineations of a green, brown, or yellow colour.
Moss Agate	T.t.	

N

Natrolite	O.	Isabella and Ochre-yellow, in wavy stripes.
Nepheline	T.t.O.o.	Colourless. Greenish, Greyish-green, Red, sometimes Opalescent.
Nephrite,	O.	Green. See *Jade*.
Nosian, or Nosine	T.t.	Blue, Greyish-blue. See *Hauyne*.

O

Onyx	O.t.	Is a banded Agate; which latter word, see.
Opal	t.o.	Bluish and Milky-white, with splendid play of colours. See *Girasol*.
Obsidian	O.t.A.	Black, Smoky-grey, or Yellow and dull-green.
Olivine	T.t.	Olive-green. See *Peridot* and *Chrysolite*.
Odontalite	O.	Blue. See *Turquoise*. (The name more especially applies to fossil-teeth, &c. coloured by salts of copper and iron.)
Ophite	t.O.	Green and other colours, often in stripes and patches. See *Serpentine*.
Orthose	T.t.o.	See *Felspar*.

P

Minerals.		Colours, &c.
Peridot	T.t.	Olive and other shades of Green. See *Chrysolite* and *Olivine.*
Prase	t.	Leek-green.
Plasma	t.	Green of different shades.
Paranthine	t.	Green, (a translucent variety of *Hornblende*).
Paulite	O.	See *Hyperstone.*
Peliom	T.t.	Dull-blue. See *Iolite.*
Perlite	t.	Pearly-grey. See *Obsidian.*
Phenakite	T.	Colourless. Pale-green.
Prehnite	T.t.	Green, Greenish-grey, Yellow.
Pyrope	T.	Fine Crimson-red.

Q

Quartz	T.O.t.A.I.	See *Crystal, Avanturine, Iris.*

R

Ruby	T.o.	Beautiful Crimson-red. See *Asteria.*
Rhætizite	t.	A pale-red variety of *Kyanite.*
Rose Quartz	T.t.	Pink variety of *Quartz.*
Rubellite	T.	Red, Pink, a variety of *Tourmaline.*
Rutile	t.O.	Dark-red, Brown.
Rhodonite	O.	Red. See *Manganese Spar.*

S

Sapphire	T.	From Indigo to pale-blue, Bluish-grey, and Colourless; also Red, Yellow, Green, &c.
Spinelle	T.	Red of different tints.
Sarde	t.	Rich Reddish-brown, or Blood-red. See *Cornelian.*
Schorl	O.	Velvet Black.
Spar	T.t.o.	Satin Spar, White and Satiny. See *Fluor Spar.*
Smaragdite	O.	Emerald-green. See *Diallage.*
Sun-stone	O.A.	Red or Yellow, with golden spots.
Sahlite	T.t.	Colourless, Green, (a clear variety of *Pyroxene*).
Siberite	T.	See *Tourmaline.*
Siderite	T.	A beautiful Blue *Quartz.*
Serpentine	t.O.	Green, &c. in stripes and patches.
Staurotide	T.t.	Dark-red.
Steinheilite	T.	Dull-blue. See *Iolite.*
Succinite	T.	Honey-yellow. A variety of *Garnet.*

T

Minerals.		Colours, &c.
Topaz	T.	Yellow, Pink, Blue, and Colourless.
Turquoise	O.	Sky-blue, Greenish-blue, and Bluish-green.
Tourmaline	T.t.O.	Green, Brown, Red, and Blue; different tints of each.
Telesie	T.	Blue, &c. See *Sapphire.*
Thallite	T.t.O.	Green, Yellowish, &c. See *Epidote.*
Thumite	T.t.O.	Violet-brown. See *Axinite.*
Topazolite	T.	A Yellow variety of *Garnet.*
Tremolite	T.t.	Colourless. Pale-green, (a clear variety of *Hornblende*).

U

Uwarowite	T.	Emerald-green. It is a variety of *Garnet.*

V

Vermeil	T.	Poppy-red. See *Garnet.*
Vesuvian	T.t.	Orange-red, Yellow, Green, Brown. See *Idocrase.*
Voraulite	t.O.	Azure-blue. See *Klaprothine.*

W

Wood-opal	O.	Resembling wood.
Wavellite	t.	Green, Greenish-grey, in radiated lines.
Wilouite	T.	Green. See *Garnet* and also *Idocrase.*
Withamite	T.t.	Rose-red. It is a variety of *Epidote* containing Manganese.

X

Xanthine	T.t.	Pale-yellow. See *Idocrase.*

Y

Yanolite	T.t.	Violet-brown. See *Axinite.*

Z

Zircon	T.t.	See *Hyacinth* and *Jargoon.*
Zoizite	t.O.	A grey variety of *Epidote.*

In my endeavour to make the foregoing list as complete as possible, I am afraid I have included in it some few minerals which are not very easy to obtain in a state fit for cutting and polishing; but you will find the same stone under different names, and this is an advantage. Thus, if you wanted an opaque blue stone for the letter A, you may still take Lapis Lazuli, for it is also called Azure-stone; or, in like manner, you may take Azure-stone for L, as it is the Lapis Lazuli. If you required a stone for the letter F, you may choose the Amazon-stone, the Adularia, or the Labradorite, or a yellow or red opaque variety, and each will do for F, as these are all varieties of Felspar. Or in the same word, you may have two Felspars; one, Moonstone, for M, and the other Amazon-stone, or Adularia, for A. In a word, you may take at your choice a generic name or a specific one.

Care should be taken, as much as possible, not to have two stones of the same colour near each other. Thus, if you wanted the name CECILIA, taking an Emerald for the E, the stones on each side should contrast with it, and not be repeated. Thus I would take for the first C a fine yellow Cairngorm, and for the second C a Cornelian or a Cinnamon-stone. The next letter being I, and this being again repeated, I would take an Iris for the first I, and a Lapiz Lazuli for the L, and an Iolite for the last I, with an Aquamarine for the final A. Thus:—

C	Cairngorm	Yellow, transparent.
E	Emerald	Green, transparent.
C	Cornelian	Red, translucid.
I	Iris	Colourless, transpt., with Iris opalescence.
L	Lapis Lazuli	Ultramarine blue, opaque.
I	Iolite	Dark-bluish grey, translucid.
A	Aquamarine	Sea-green, transparent.

I will give one more example, taking your own name, dear Florence, for the subject.

F Felspar.
L Lapis Lazuli.
O Opal.
R Ruby.
E Emerald.
N Natrolite.
C Cornelian.
E Essonite.

With this I now conclude these letters; and if they shall have been the means of awaking your interest in the class of objects to which they relate; of shewing you that they are among the most useful of those which an all-provident Being has placed at the disposal of man;—if, in a word, they shall have increased your general knowledge, and afforded you fresh reasons for gratitude to God, and convinced you of the truth that "there are sermons in stones," I shall indeed feel much gratification. I need hardly repeat, dear Florence, that I have had no intention of writing a treatise on Minerals. Many such exist, and I have made free use of them in the course of this correspondence. Whatever you may wish to know beyond what I have communicated to you, may be learned in the works of Hauy, Berzelius, Phillips, Cleveland, Beudant, Brongniart, Brard, Mohs, Jameson, and a variety of others. I would most particularly recommend two excellent works by Mr. E. J. Chapman, the one entitled "*A Description of the Characters of Minerals*," and the other "*Practical Mineralogy*." I do not however think it necessary that, as a lady, you should distort your features by puffing at a blow-pipe, blacken your delicate fingers with handling charcoal, or burn holes

in your dress with sulphuric acid. To know something of the more important minerals, the places whence they come, and the uses to which they are applied, I apprehend to be sufficient for you; and with this knowledge, you will find a stroll among the minerals of a museum a much more rational and interesting pastime than it can possibly be to those who stare in stupid wonder and perfect ignorance at what they see.

APPENDIX.

A TABULAR DISTRIBUTION OF THE MORE COMMONLY OCCURRING MINERALS, BY MEANS OF WHICH THEY MAY BE EASILY RECOGNISED.

TABLE I.

Minerals which present a glassy, pearly, or stony appearance, and which are hard enough to scratch window-glass.

A. *Minerals which are too hard to be scratched by a knife or other instrument.*

Corundum, including:

Sapphire: Blue, grey, &c.; transparent and glassy; scratching rock-crystal with ease.

Ruby: Red, pink, &c.; transparent and glassy; scratching rock-crystal with ease.

Adamantine Spar: Brown, green, red; translucent, opaque; scratching rock-crystal with ease.

Emery: Greyish-black; opaque; scratching rock-crystal with ease.

Spinelle: Red, black, rarely bluish-grey; T. or O.; in small octahedral crystals; nearly as hard as the true *ruby*.

Zircon, including:

Jargon, Hyacinth, &c.: Yellowish-red, brown, &c.; T. or O; scratching quartz.

Topaz: Yellow, bluish, colourless; T.; harder than quartz; in four-sided prisms, or rolled pebbles, which, when broken, shew a foliated structure.

Emerald: Green; T.; in six-sided prismatic crystals.

Beryl: A coarse or pale-coloured variety of *emerald*; bluish-green, yellow, colourless, &c.; often in very large six-sided prisms.

Iolite: Dull-blue, sometimes yellowish-brown by transmitted light.

Garnet: Dark-red, crimson, yellow, brown, green, black; T., t., or O.; harder than quartz; massive, or in round-looking twelve-sided crystals, each face of which is shaped like the diamonds on playing-cards.

Idocrase: Orange-red, brown, green, &c.; very closely resembling certain *garnets;* but the crystals are generally four-sided prisms, surmounted by pyramids with flat summits.

Epidote: Dark-green, yellowish-green; T., t., or O. Crystals often striated longitudinally.

Axinite: Clove-brown, violet, green; T. or t.; in flat sharp-edged crystals.

Tourmaline: Green, blue, red, pink, &c.; in three-, six-, or nine-sided prisms, which are opaque when viewed longitudinally, with the exception of the light-coloured varieties.

Schorl, a black opaque *tourmaline. Rubellite,* a pink *tourmaline.*

Opal: Colourless, with a beautiful iridescence; in massive or shapeless pieces, presenting a compact structure.

Semi-Opal, Wood-Opal: Yellow, brown, grey, milky, &c.; t. or O.

Quartz—Rock-Crystal: T. glassy, sometimes iridescent; in six-sided prisms, streaked across, with pointed summits. *Cairngorm:* yellow, smoky. *Amethyst,* violet-coloured, more or less deep. *Rose-* and *Milk-Quartz:* of a pink or milk-white aspect. *Calcedony:* white, pale-blue, yellow; t. only. *Carnelian:* a red calcedony. *Prase:* dark green. *Heliotrope:* dark green, sometimes with red spots (*bloodstone*). *Chrysoprase:* an apple-green *calcedony. Plasma:* green. *Cat's-eye:* grey, brown; opalescent. *Jasper:* red, green, brown, &c.; dull; O. *Lydian stone:* black, O. *Flint.*

Tin Stone: Brown, grey, &c.; feels exceedingly heavy.

B. *Minerals which may be scratched by a knife with more or less difficulty.*

Lapis Lazuli: Azure-blue, with feeble lustre; O.

Hauyne: Bright-blue, bluish-green, with shining, glassy lustre; T. Found in lava and other volcanic products.

Turquoise: Sky-blue, bluish-green; waxy-looking; O.

Kyanite: Light-blue, grey, white, reddish (the variety termed *rhætizite*); of a "bladed" or "broad-fibrous," structure, and pearly-vitreous lustre; T. or t.

Felspar: White, grey, red, green (*amazon stone*), &c., sometimes opalescent (*moon-stone*); transparent (*adularia*), t. or O.; glassy, pearly, or stony in appearance, and of a lamellar structure.

Albite: White, &c. resembling *felspar.*

Obsidian: Grey, black, brown, &c.; T. t. (*marekanite*) or O.; in shapeless pieces with very sharp edges, and of a compact structure.

Labradorite: Grey, with splendid reflexions of blue, green, purple, red, and orange; t. or O.; in shapeless masses, presenting a lamellar structure.

Chiastolite: White; in compound crystals, presenting a dark cross in the interior, and imbedded in clay-slate.

Rhodonite: Pink or red, sometimes brownish; O.; in shapeless masses. It is often termed *Manganese-Spar.*

Pyroxene: Augite: Dark-green or black; O. *Diopside:* fine green or pale-green; t. rarely T. *Sahlite:* light-green or colourless; t. *Coccolite:* dark-green; in small granular masses. The *Augite* is commonly crystallized; the crystals are generally six-sided or eight-sided, with two sloping planes at each summit.

Hornblende, Basaltic Hornblende: Black or dark-brown, in six-sided crystals, with three or more planes at each summit. *Actynolite:* green of various shades, crystallized or fibrous. *Tremolite:* a white or pale-green *actynolite*. *Asbestus* and *Amianthus:* white or green; in soft fibrous masses.

Apatite: White, green, blue, &c.; T. or t.; in regular six-sided prisms; the summits generally flat. It scratches glass with difficulty.

NOTE 1. *A very small fragment of any one of the above Minerals held in the outer edge of the flame of a candle, by means of a pair of tweezers or old scissors, remains unaltered.*

Prehnite: Green, white; in small radiated crystals, harder than felspar. Lustre, somewhat pearly.

Natrolite: Yellow, in radiated or wavy lines. *Mesotype:* the same mineral in colourless, needle-like crystals.

Datholite: White, green; t.; radiated, globular, or crystallized. Lustre, somewhat waxy and vitreous.

NOTE 2. *A very small fragment of any one of these Minerals treated for an instant as described above* (*see* NOTE 1), *becomes milk-white and opaque.*

N.B.—All the harder Minerals known by the old name of *Zeolites,* might be arranged here, as *Harmotome* or *Cross-stone; Analcime; Thomsonite,* &c.

TABLE II.

Minerals which present a glassy, pearly, or stony appearance, but which are not hard enough to scratch window-glass.

A. *Minerals of which the powder or scratched surface is white.*

---

1 *Minerals which treated as in* Table I. (Note 1), *remain unaltered.*

Mica: Grey, white, green, black, &c.; flexible and elastic; easily separable into thin leaves. Some varieties become white and opaque when held in the flame of a candle.

Lepidolite: Pink, rose-red, greyish; t. or O.; pearly.

Talc: White, apple-green; flexible, but not elastic; unctuous to the touch; t. or O.

Chlorite: Fine green, often resembling the wing-cases of the rose-beetle; t. or O.; not unctuous to the touch.

Serpentine: Green, brown, often with veins and patches of red and other tints; in shapeless masses, which can be easily cut.

2 *Minerals which treated as in* Table I. (Note 1), *become milk-white and opaque.*

Stilbite: White, red, brown, radiated; fine pearly lustre.

Wavellite: Green of various tints, white, grey; in globular and radiated groups, chiefly on clay-slate.

Gypsum: White, grey, rarely stained yellow, &c.; T.t., or O.; pearly; flexible in thin pieces; easily cut; scratched by the nail.

Arragonite: Colourless, violet-blue, &c.; in crystals, and in fibrous and coral-shaped masses.

3 *Minerals which treated as in* TABLE I. (NOTE 1), *decrepitate or fly to pieces with violence.*

Heavy Spar: Yellow, white, &c.; feels very heavy; usually associated with metallic ores.

Celestine: Colourless, pale-blue, &c.; feels heavy, but less so than the above; rarely associated with metallic ores.

Fluor Spar: Colourless, violet-blue, green, yellow, &c.; T. or t.; usually in cubical (dice-shaped) crystals, the corners of which break off easily.

Rock Salt: Grey, white, reddish, &c.; strongly saline to the taste.

Calc-Spar: Colourless if pure, otherwise black, yellow, reddish, &c.; if transparent, doubly refracting; when broken, the fragments take the form of small rhombs. Some varieties remain unaltered in the flame of a candle.

Amber: Yellow, &c.; feels very light; in the flame of a candle it takes fire and burns.

B. *Minerals of which the powder or scratched surface is coloured.*

Malachite: Green, generally in wavy or radiated lines; opaque; powder, pale-green; massive.

Blue Copper: Fine azure-blue; T. or t.; generally in small crystals grouped together; powder, pale-blue.

Ruby Copper: Dark-red; powder, brownish-red; generally in small octahedral crystals.

Ruby Silver: Red, more or less deep; feels very heavy. Lustre of the dark-red species, slightly metallic.

N.B.—The *Arseniates* and *Phosphates of Copper; Realgar* and *Orpiment; Cinnabar; Chromate of Lead; Cube Ore;* earthy specimens of *Red* and *Brown Iron-ore; Phosphate* of *Uranium,* &c., belong also to this group.

TABLE III.

Minerals which present a metallic appearance, and which are hard enough to scratch ordinary window-glass.

Iron Pyrites: Yellow; powder, black; often in cubes. It strikes fire with steel.

Radiated Iron Pyrites: pale brass-yellow; powder, black; generally in globular masses, which, when broken, shew a radiated structure.

Cobalt Glance: Silver-white, tin-white; powder, black; in small brilliant crystals.

Arsenical Nickel: Copper-red; powder, black; in shapeless pieces; feels very heavy.

Magnetic Iron Ore: Iron-black; powder, black; in crystals or shapeless masses which attract the magnet, and generally possess polarity.

Iron Glance: Dark steel-grey or red: powder, brownish-red; in brilliant flat-looking crystals, aggregated into groups, and often beautifully tarnished, as in the Elba specimens. Also in globular and radiated masses (*red hæmatite*), and in shapeless pieces, the appearance of which is scarcely metallic.

Brown Iron Ore: Brown; powder, brownish-yellow; in globular and radiated masses (*brown hæmatite*), or in shapeless pieces possessing a sub-metallic, and sometimes an earthy appearance.

Wolfram: Brownish-black; powder, reddish-brown; feels exceedingly heavy.

TABLE IV.

Minerals which present a metallic appearance, but which are not hard enough to scratch window-glass.

A. *Malleable.*

Native Gold, *Native Silver*, *Native Copper*, — Colours, &c. well-known. *Gold* and *Silver* usually occur in small leafy or filiform masses, which are often composed of minute crystals. *Copper* is found in aggregated crystals or in shapeless masses.

Sulphuret of Silver: Blackish lead-grey. It occurs in the same forms as *Native Silver*, from which it is distinguished by its dark colour.

B. *Brittle; colour, grey or black.*

Molybdena Glance: Lead-grey; scratched by the nail; unctuous to the touch. In small leafy and flexible masses, which leave a black trace on paper, and a dark-green one on smooth porcelain.

Graphite (*plumbago*): Iron-black; unctuous to the touch; leaves a black mark on porcelain. It is sometimes called "black lead," but contains no trace of that metal.

Sulphuret of Copper: Dark lead-grey; easily cut, and then presenting a shining lustre.

Galena, Sulphuret of Lead: Lead-grey; powder, dark-grey; in crystallized or shapeless masses, which break easily into square or rectangular fragments.

Sulphuret of Antimony: Light-grey, often beautifully tarnished; generally in fibrous masses.

Native Arsenic: Light-grey, tarnished black externally; often in globular pieces.

Grey Manganese: Steel-grey; powder, reddish-brown; generally in fibrous or acicular groups; brittle; tolerably hard.

Pyrolusite, Manganese Ore: Black; powder, black; soft; soils the hands when touched.

C. *Brittle; yellow or reddish.*

Copper Pyrites: Fine yellow; powder, greenish-black; often in triangular-looking crystals. It contains copper, iron, and sulphur.

Purple Copper: Brownish-red, with a fine greenish-blue iridescent tarnish; powder, black; in shapeless masses.

Magnetic Pyrites: Bronze-yellow or brown; powder, black; tolerably hard; in shapeless masses, which slightly affect the magnet.

INDEX.

THE END.

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